SEA GRANT PROJECT OFFICE

THE MARKETABILITY OF SQUID

by

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ABSTRACT

The current trends of seafood supply shortages and price hikes have made government and industry people look at new seafood species in order to fulfill the increasing domestic demand for the ocean's products. One of the more promising species for use as a human food product is squid.

While squid is eaten in many areas of the world, it has gained very little acceptance in the U.S. market. Some strong negative attitudes towards squid persist among American consumers.

This work attempts to determine the market potential for three processed squid products which were developed at M.I.T.: a squid chowder, a squid cocktail, and fried squid rings.

Market research, aimed at estimating the potential trial and repeat purchase rates for these squid products, was conducted in the Boston metropolitan area. The results show that while repeat purchase would be high, trial purchase would be extremely low (due to the strong negative attitudes towards squid held by the American consumer). Combining these results with the characteristics of the seafood industry, a conclusion of not introducing these products onto the domestic market was reached.

However, during the course of the research, certain interesting possibilities in the export of squid to Europe and in new product concepts were uncovered.

ACKNOWLEDGMENTS

I would like to thank the many members of the seafood industry who patiently provided me with information vital to this study. Particular thanks go to Graham Lusk and James Ackert of Gorton's Seafoods, Inc., Sidney Cohen of Sea-Mark, Inc. and William Stride of Turner Fisheries.

In the course of my investigations I found the resources of the National Marine Fisheries Service to be very helpful. Special thanks go to Warren Rathjen, N.M.F.S Gloucester, Massachusetts and Susumu Kato, N.M.F.S. Tiburon, California.

My colleagues at M.I.T. were particularly helpful in guiding my thinking and encouraging my progress. Professors Zeki Berk and Ernst R.Parisier were of great help at the outset of my work, while my co-advisors, Professor Gordon Bloom and Professor Samuel Goldblith, provided me with knowledge, advice and inspiration throughout the course of my investigations.

Finally, I must thank my wife Joan. She patiently participated in every step of this work and provided the understanding which made this work possible.

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A. INTRODUCTION

A program of investigation was initiated in 1971 in the Department of Nutrition and Food Science at M.I.T. to determine the potential value of squid as food for the American consumer. The project was funded in part by the M.I.T. Sea Grant Program and was specifically designed to study:

1) Methods of processing squid for the manufacture of food products,

2) the chemical characteristics of squid muscle proteins,

3) the acceptability of squid and squid products by the American consumer.

This report deals with the last of these questions and is an account of the work done by the author from June 1973 to May 1974.

Due to current supply shortages and price hikes of various seafoods, the government and private organizations are investigating the possibility of using several under-utilized marine animals as a source of food for human consumption. In order to be suitable as a human food, marine animals must be palatable, nutritious, and capable of being caught economically. Squid is quite acceptable on all three accounts; however very little is known regarding the poten-

tial demand for it. This work hopes to determine where demand for squid products exists, which products exhibit potential for success, and how to market these products most effectively.

While I have strived to look at the question of marketing squid to the entire U.S. market, actual market research has been limited to the Boston metropolitan area. This was necessitated by time and financial constraints. Thus, any extrapolation of results beyond this area must be viewed carefully due to the high seafood orientation and demographic characteristics of the Boston area. In conjunction with this viewpoint, an emphasis has been placed on the possible establishment of a squid fishery in the New England area.

B. OPPORTUNITIES

The current trend of rising food prices coupled with supply shortages of certain seafood species makes the introduction of a new seafood product particularly timely. Price hikes for such species as lobster, shrimp and clams have been particularly alarming. These price hikes can be attributed to both supply and demand factors.

From the supply side, four factors have limited the amount of the American catch:

1) Certain species, like salmon and tuna, have been fished so intensively that landings are now at or near the

current technology's potential harvest. While American fishermen fish for over 200 species, ten of these account for 75% of the total U.S. catch.[1]

2) Foreign fishing, in what was once exclusive American fishing waters, has limited the U.S. catch. For example, the Northwest Atlantic, one of the richest fishing areas of the world, has been infiltrated to such an extent that 80% of the catch off the New England and Canadian shores has been by foreign vessels.[2] The Japanese, Russians, Spaniards, Poles, West and East Germans have fished extensively in these waters.

3) The American fishing fleet has fallen technologically behind those of the Japanese and Russians. The large factory boats employed by the Japanese and Russians are many times more efficient than the traditional New England trawler.

4) Habitat modifications such as harbors, nuclear plants and dams have locally upset the ecology of many species. In the same way, pollution has had a detrimental effect on our fish resources.

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1 Shapiro, Sidney, Our Changing Fisheries, United States Printing Office, Washington, D.C., 1971, p. 24

2 Ibid., p.25

In contrast to species displaying present and future supply shortages, squid is believed to be in ample supply and is currently vastly underharvested. Also, squid can be caught economically employing either current or new fishing apparatus and put onto market at a lower price than most fish species.

Aggravating the supply problem is the highly selective nature of the U.S. fish market. While American per capita consumption is low compared to other countries, the narrow range of acceptable products puts intense pressure on these species. Although this pressure tends to raise the price of these species, thus inviting new species introduction at lower prices, this phenomenon may also create an effective barrier to new seafood product introduction. However, as witnessed by recent beef price hikes, Americans will use substitutes in their food diets once existing product prices get out of hand, a situation which many believe is currently facing the seafood industry.

Since squid is easily digested, has a high protein content, and has an appealing flavor, it is regarded as a prime candidate for human consumption. Squid has another advantage in that 80% (by weight) of its body is edible, compared to yields of 40%-70% for most marine animals.[3]

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3 Idyll, C.P., "Resources of the Sea-Part Two: Food Resources of the Sea beyond the Continental Shelf Excluding Fish", U.N. Economic and Social Council, February 1968, p. 53

Finally, squid may have significant utilization in industrial products such as fishmeal, high protein concentrate fillers, and oil reduction by-products.

C. DIFFICULTIES FORESEEN

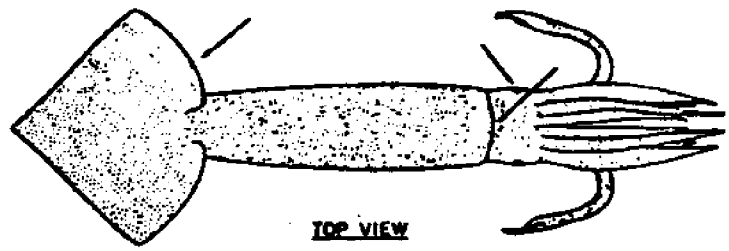
The general problem of introducing a new fish product onto the American market has already been touched on. The assumption held here is that new product introduction will become necessary in the near future. The question at hand is the viability of squid in meeting this role. Although the supply and potential price of squid are favorable, certain difficulties, particular to squid, are foreseen.

Squid is not one of the more familiar marine animals to the American consumer - except for those of Mediterranean extraction. The actual level of awareness in the U.S. of squid is unknown. Since squid is not a familiar item, it can be theorized that it will meet with a great deal of opposition. However, some prevailing opinions suggest that this non-familiarity may actually be a blessing in disguise.

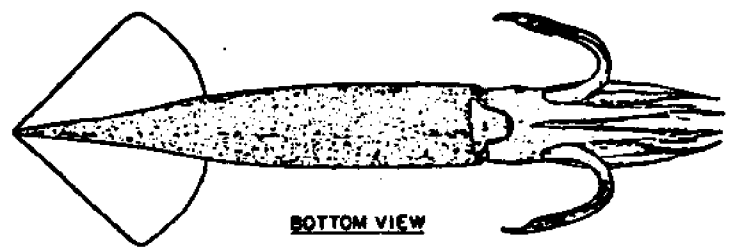
Not only does the U.S. population have a low level of awareness of squid, but also attitudes towards it seem to be quite varied. Of those who know what squid is, the range of attitudes goes from a seafood delicacy to a Jules Verne sea-monster. The actual word SQUID and the foreign appearance (Illustration 1-1) of the animal have created a negative attitude towards its use for human consumption

Illustration 1-1

SQUID

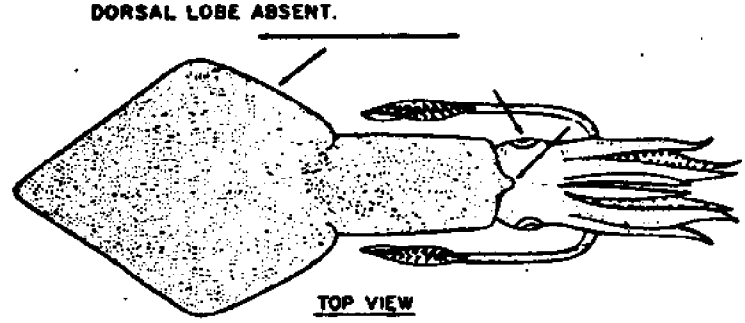


TOP VIEW

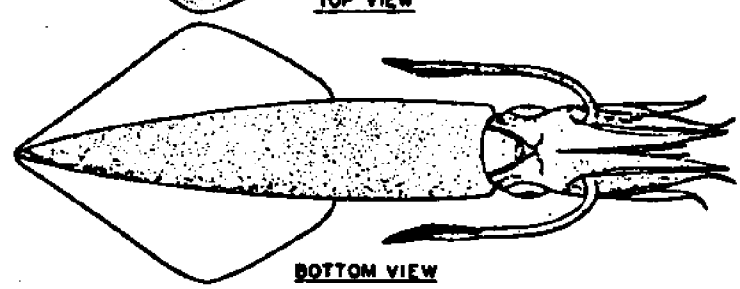


BOTTOM VIEW

(Ommastrephes illecebrosa)
ILLEX SHORT-FINNED SQUID *(summer squid)*
FINS ABOUT 1/3 THE MANTLE (BODY) LENGTH.
EYE OPENING SMALL.
DORSAL LOBE ABSENT.



TOP VIEW



BOTTOM VIEW

(Loligo pealii)
LOLIGO LONG-FINNED SQUID *(winter squid, common squid)*
FINS LONGER THAN 1/2 THE MANTLE (BODY) LENGTH.
EYE OPENING LARGE.
DORSAL LOBE PRESENT.

among many people. Any attempt to change the name for package labelling will likely be contested by the Food and Drug Administration.

In addition, a small level of negative appeal may have been created among people who have tried squid and have had it poorly prepared. Complaints about its texture and coloring have been encountered. However, proper preparation should alleviate these problems.

Another potential problem area is the need to obtain the cooperation of a number of marketing intermediaries. Since there exists only a very limited squid industry in the U.S. at present, the questions of whether fishermen will fish for squid and if processors will process squid, are as important as whether or not Americans will eat squid.

D. ASSUMPTIONS AND STRATEGY OF STUDY[4]

Certain initial assumptions were made by the M.I.T. team conducting investigations into the potential value of squid:

1) Squid is available in the Northwest Atlantic in sufficient quantities to permit industrial utilization.

2) The price of squid, even when fished, transported,

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4 This section is largely based on:
Berk, Zeki, "Processing Squid for Food", M.I.T. Sea-Grant Program, Report No. MITSG 74-13, Massachusetts Institute of Technology, Cambridge, February 15, 1974

and landed as a food fish, will be low compared to other fish and seafood.

3) The "conventional" uses of squid as food (Japanese, Mediterranean, South American) would not be suitable as a starting point for large volume exploitation. Therefore, new processed products must be developed in which squid merely replaces (mimics) another accepted seafood.

4) Even then, considerable market resistance may be expected to anything called squid. The magnitude of this resistance must be tested.

5) The process developed must fit into the existing processing facilities with minimal extra investment.

6) Handling of squid by existing technologies is labor consuming. Mechanized or machine assisted handling methods must be developed.

Chapter 2 - What is Squid?

Squid are marine animals of worldwide distribution, with over 300 different species known. These species display a remarkable diversity of structure, function, behavior and ecology. Most are active, highly mobile animals of aggressive habits, and they are probably all carnivorous. Characteristically animals of the high seas, considerable populations of squid frequently are found closer to shore.

Squid vary from an arrow shaped creature to that of a balloon shaped one. However, the streamlined body is the more common and aids in its rapid movements. Although squid cannot maintain high speeds for an extended length of time, while in motion, they may be the fastest creatures of the ocean. Their movements, equally swift forward or backwards, are facilitated by a true jet propulsion system. Squid will suck in water and then shoot it out, causing their body to react quickly and in dart-like patterns.

As a member of the Cephalopod (meaning feet around head) family, squid are often confused with their relatives the octopus and the cuttlefish. Most squid species have eight tentacles and two arms that surround the head. The main body section, the mantle, has two fins attached on the back. Both mantle and tentacles can be utilized for human consumption.

The nutritional value of squid is high, comparing

favorably with most fish species. Squid is high in protein and phosphorus with traces of calcium, thiamine and riboflavin. Research has shown that raw squid contains 78 calories per 100 grams.[1]

The average life span of squid is generally very short. While some species, such as the giant squid, may live for ten years, most live an average of only two years. These species grow rapidly from birth and attain full size in less than a year. This short life span allows for more extensive fishing of existing populations than in most other seafood species, and makes it possible and more economical to raise squid in captivity.

Commercially, there are three species that would be important to the American fisherman. Along the east coast two species are widely distributed and suitable for human consumption. They are the short finned squid, Ommastrephes illecebrosa (Illex), which fishermen call the summer squid or flying squid, and the long finned, Loligo peali also called winter squid or common squid. The species that predominates along the west coast is the Loligo opalescens.

Currently only Illex is caught in the Northwest Atlantic. A small squid fishery has formed off Newfoundland

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1 Veteikis, J.J., "Commercial Fishing for Squid", Australian Fisheries Newsletter, No. 25, Fisheries Branch, Dept. of Primary Industry, Australia, June 1966

which takes in about four million pounds of Illex a year. Most of this catch is used as bait for the cod fishing industry. While Illex is found in large quantities off the Canadian and New England coasts, large amounts have been found as far south as the Caribbean. However, the Illex inhabit deeper and deeper waters the farther south one searches. Likewise, the Loligo peali can be found along the entire eastern coast of the United States. While generally a creature of the near and outer continental shelf, the Loligo peali migrate inshore during the spring months.

The small squid fishery which does exist in the United States is based in California. Here the Loligo opalescens is the only species caught. About twenty million pounds of this species are caught annually, generally between April and July.[2]

Although most of the United States' landings of squid are along the west coast, the east coast squid is preferable for human comsumption due to its larger size and thicker body meat. Of the two important east coast species, there is some question as to whether they would serve equally as well as human food. With proper preparation, this researcher believes the differences to be nearly indistinguishable.

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2 Lyles, C.H., Historical Statistics - The Squid Industry, U.S. Dept. of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, C.F.S. No.4833, H.S. No.14, Washington, D.C., November 1968, p.9

The Ommastrephes sloani pacificus or Japanese Flying squid is the predominant species of the large Japanese catch. It annually accounts for around 90% of the Japanese landings. The Japanese Flying squid is found off the coasts of Japan and in the Northwest Pacific. The species common to the European market is the Loligo vulgaris. This species is found in the Mediterranean Sea and off the coast of Africa. Calamari or Calamar is the common name for squid among Italian and Spanish peoples.

Squid are also used extensively in biology classes and marine laboratories. Their giant nerve fibers make them particularly valuable in neurophysical research.

Chapter 3 - U.S. Fishing Industry

In 1960 the total U.S. landings of fish and seafood was 4.9 billion pounds.[1] In 1972 the total U.S. landings of fish and seafoods was 4.7 billion pounds.[2] These figures serve to illustrate the stagnant nature of the U.S. fishing industry. In fact, the U.S. position had deteriorated so rapidly in comparison to the rest of the world that the U.S., now the largest importer of fishery products in the world, is no longer one of the top five fishing nations of the world. Table 3-1 illustrates this deteriorating position quite vividly. As demand has outstripped supply, the U.S. has become increasingly dependent on fish and seafood imports. In 1972 imports exceeded exports by over one billion dollars (imports - $1,233,292,000, exports - $157,908,000).[3] This international trading of fishery products has adversely affected the U.S. balance of trade for many years. Initial indications show that a fairly large market for squid may exist in Europe. If the U.S. could economically fish for squid off its shores, it might

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1 U.S. Dept. of Commerce, Fisheries of the United States, 1972, Current Fisheries Statistics No. 6100, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, U.S. Printing Office, Washington, D.C., March 1973, p. 24

2 Ibid.

3 Ibid., pp. 39, 44

Table 3-1

Catch of Fish, Crustaceans, Mollusks and other Aquatic Plants and Animals by leading Countries, 1956-1971 (live weight basis - million lbs)

Year	Country	Million lbs.	Year	Country	Million lbs.
1956	Japan	10,522	1962	Peru	15,793
	U.S.A.	6,574		Japan	15,139
	China	5,838		U.S.S.R.	7,973
	U.S.S.R.	5,767		China	7,751
	Norway	4,822		U.S.A.	6,554
1957	Japan	11,921	1963	Peru	15,632
	China	6,878		Japan	14,768
	U.S.A.	6,074		China	8,785
	U.S.S.R.	5,580		U.S.S.R.	8,768
	Norway	3,849		U.S.A.	6,122
1958	Japan	12,136	1964	Peru	20,550
	China	8,951		Japan	14,001
	U.S.A.	5,960		China	10,505
	U.S.S.R.	5,778		U.S.S.R.	9,867
	Norway	3,180		U.S.A.	5,773
1959	Japan	12,972	1965	Peru	16,825
	China	11,067		Japan	15,229
	U.S.A..	6,373		China	11,757
	U.S.S.R.	6,076		U.S.S.R.	11,243
	Peru	5,101		U.S.A.	6,006
1960	Japan	13,652	1966	Peru	19,499
	China	12,787		Japan	15,657
	Peru	8,217		China	12,414
	U.S.S.R.	6,726		U.S.S.R.	11,792
	U.S.A.	6,205		Norway	6,329
1961	Japan	14,794	1967	Peru	22,484
	China	12,787		Japan	17,307
	Peru	12,016		U.S.S.R.	12,736
	U.S.S.R.	7,165		China	11,435
	U.S.A.	6,464		Norway	7,200

Table 3-1 (continued)

Year	Country	Million lbs.
1968	Peru	23,271
	Japan	19,113
	U.S.S.R.	13,409
	China	11,907
	Norway	6,296
1969	Peru	20,807
	Japan	18,989
	U.S.S.R.	14,324
	China	12,202
	Norway	5,491
1970	Peru	27,807
	Japan	20,536
	U.S.S.R.	15,988
	China	13,790
	Norway	6,570
1971	Peru	23,394
	Japan	21,815
	U.S.S.R.	16,175
	China	15,168
	Norway	6,779

Note:--Data reflect latest information published in the various volumes of Yearbook of Fishery Statistics, Food and Agriculture Organization of the United Nations.

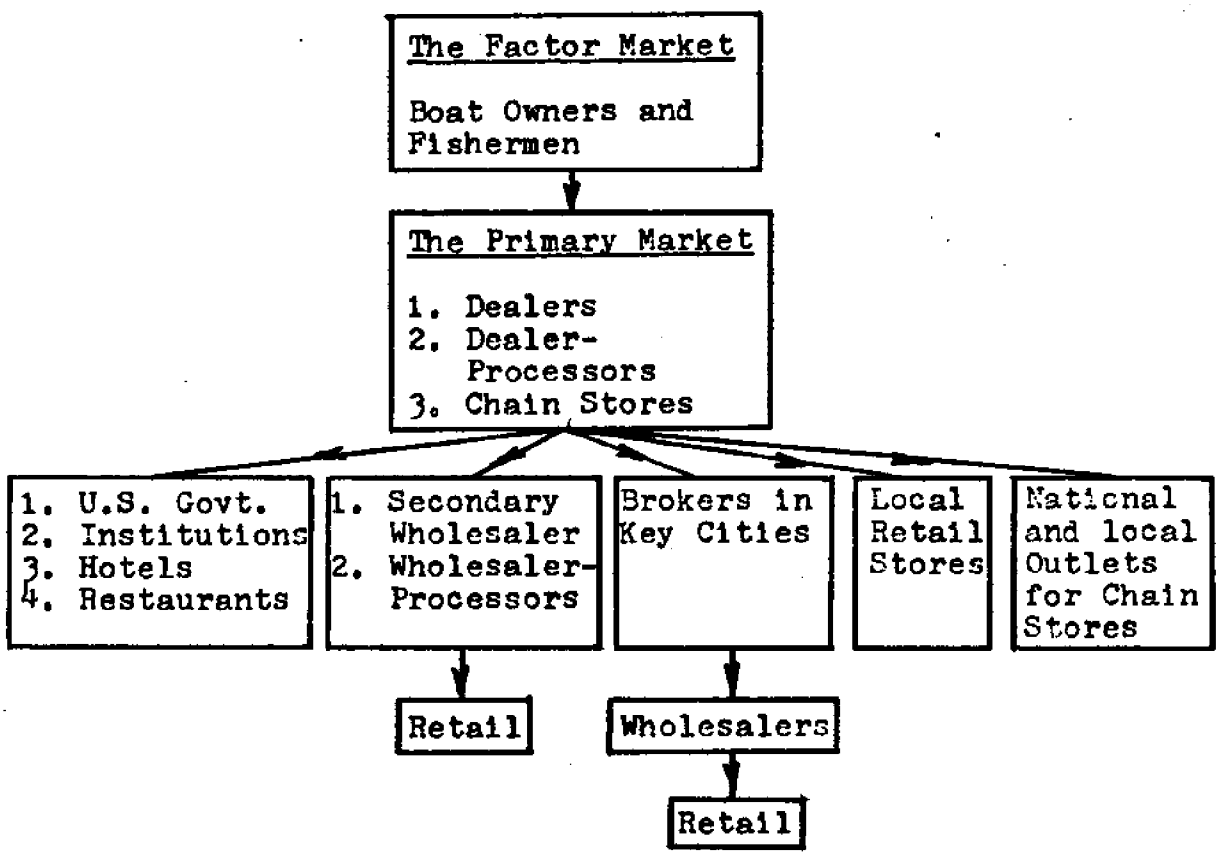
be able to initiate a profitable export trade of squid.

The question of whether or not fishermen will fish for squid is largely a matter of dollars and cents. If the fishermen are paid a high enough price for squid, they would fish for it. However, fish and seafood products move through a variety of market channels from the point of landing to the final consumer. All of these channels must, in turn, accept the viability of and pay a good price for the products to be sold. Exhibit 3-1 depicts graphically the typical chain of markets for the New England fish industry.

If processed squid products were to be introduced to the American consumer through the New England fishing ports, these products would most likely move from fishermen to processors to brokers to retail outlets. The fishermen to processor (or dealer) transaction is most commonly executed by means of an auction. Processors and dealers daily bid for shiploads of freshly caught fish. The Boston Fish Pier is the center of such activity in the New England area. However, Gloucester and New Bedford both maintain auction halls owned by the local fishermen's union. The major disadvantage of the auction system is that day to day landing fluctuations get translated into daily price fluctuations. Larger processors, in an attempt to reduce the risk of supply fluctuations, will enter into negotiated

Exhibit 3-1

The Chain of Markets for New England Fresh and Frozen Fish[4]



4. Adapted from: Fishing Ports and Markets, Food and Agriculture Organization of the United Nations, Fishing News Ltd., London, 1970, p. 220

contracts or help finance fishing vessels in return for the ships' entire catch. Under this method the catch is generally sold at current market prices to the processors. The largest processors, in an attempt to reduce the risk of price fluctuations, will own fishing vessels outright.

A study by Gaston and Storey[5] involved a detailed analysis of market channels for fresh fish originating at the Boston Fish Pier. The authors estimated that less than 25% of the fresh fish was handled by restaurants and institutions. The remaining 75% was sold at retail establishments: 61% through retail grocery stores and 39% through retail seafood markets.

Since processed fish products are more likely to be sold by retail outlets than by restaurants and institutions (many of which prefer to "process" the fish themselves) the emphasis of the M.I.T. study has been at the retail trade. Furthermore, since retail seafood markets rarely sell processed products, I have limited my investigations to the retail grocery trade.

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5 Gaston, F.L. and Storey, D.A., "The Market for Fresh Fish that originate from Boston Fish Pier Landings.", Recent Developments and Research in Fisheries Economics, edited by F.W. Bell and J.E. Hazelton, Ocean Publications, Inc., Dobbs Ferry, New York 1967

Chapter 4 - The Squid Industry

A. CURRENT MARKETS AND PRODUCTS

It may come as a surprise to many Americans, but squid is a heavily consumed and highly sought after food form in many areas of the world. Squid is particularly popular among the peoples of the Orient and of the Mediterranean. The Japanese enjoy their squid either fresh (to be fried), dried, marinated or smoked and it has become a staple in their food diet. In Italy and Spain squid is regarded as a delicacy and is prepared by stewing the squid meat in tomato sauce or in its own ink.

The large Japanese market of over 800 million pounds per year is supplied almost in total (small amounts are imported from the South Koreans) by Japanese fishermen.[1] The Mediterranean market is supplied from fisheries in the Mediterranean, off the west coast of Africa, and off the east coast of North America. In addition, Japanese fishermen sell large quantities of squid (caught off the North American coast) to the Mediterranean countries.

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1 Squid are often landed as an auxiliary catch to other species and go unrecorded. Sometimes squid landings are totalled into a larger, more general categorization such as mollusks. Therefore, accurate statistics on squid landings are impossible to obtain. Official FAO statistics put the Japanese catch at around 600 million pounds per year. However, various experts believe the figure to be closer to one billion pounds per year.

At present only a small market for squid exists in the United States. Squid is sold in fresh fish markets of Boston, New York, San Fransisco and other large cities that have concentrations of people of Italian, Greek, or Oriental background. Frozen squid, in the form of three or five pound packs, are sold in certain supermarkets and groceries in urban areas. Squid dishes can also be found in certain Greek and Italian restaurants. At present this ethnic market is quite small and accounts for about ten million pounds of squid a year.[2] Almost all the squid consumed in the U.S. is caught off the coast of California.

Squid is widely used as bait for fishermen. A large portion of Canada's squid landings is used as bait for the cod industry.

B. LANDINGS AND POTENTIAL RESOURCE

Accurate statistics on the landings of squid are impossible to obtain since large quantities of squid go unrecorded in official statistics. However, the best estimates tend to put worldwide landings at around 1.5 billion pounds annually.[3] Of this, Japan usually accounts

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2 Derived from U.S. Department of Commerce statistics.

3 See footnote #1.

for two thirds, annually landing from 600 million to one billion pounds.[4] Most of the Japanese catch is of the Ommestrephes sloani pacificus (flying squid) species, and is caught off the coasts of Japan. However, the Japanese also have fished for squid off the west coast of Africa and off both coasts of the United States. The South Koreans and Spaniards are also large fishers of squid. Canada annually takes in around 20 million pounds of Illex; almost half of which is used for bait in the cod industry.[5]

In the United States over 90% of the 20 million pounds of squid landed annually is taken in off the coast of California.[6] On the east coast, squid is rarely sought after directly, and is usually caught as an incidental catch to other species. The New England fishery may take in around two million pounds of squid this way a year.[7] This catch is used as bait or sold fresh in the fish markets of the larger New England cities. Historical statistics of the U.S. squid fishery are shown in Table 4-1.

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4 Ibid.

5 Taken from the latest issues of the Yearbook of Fishery Statistics, Food and Agriculture Organization of the United Nations.

6 Lyles, C.H., Historical Statistics - The Squid Industry, U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, C.F.S. No. 4833, H.S. No. 14, Washington, November 1968

7 Ibid.

Table 4-1

Historical Squid Statistics, 1940-1967

(Thousands of pounds and thousands of dollars)

Year	New England		Pacific Coast		Total U.S.	
	Quantity	Value	Quantity	Value	Quantity	Value
1940	1,752	22	1,863	32	6,540	108
1941	NA	NA	1,640	35	1,923	39
1942	1,088	35	961	33	2,963	136
1943	1,042	58	9,166	265	11,298	433
1944	957	52	10,939	299	12,960	458
1945	1,652	91	15,228	426	18,276	633
1946	1,049	49	38,025	1,215	39,221	1,285
1947	1,649	90	14,551	392	17,054	567
1948	2,576	167	19,258	518	23,813	867
1949	4,635	124	6,860	184	13,793	409
1950	1,403	57	5,996	157	8,437	280
1951	4,020	147	12,383	336	17,986	613
1952	814	72	3,672	171	5,739	342
1953	4,499	211	8,917	206	14,546	489
1954	2,633	82	8,156	177	11,797	335
1955	2,605	101	14,272	234	18,419	416
1956	1,907	81	19,484	337	22,549	510
1957	4,446	138	12,449	208	18,498	455
1958	2,569	108	7,475	148	11,853	360
1959	2,356	137	19,694	345	23,373	576
1960	2,098	160	2,562	72	6,216	340
1961	1,221	105	10,286	280	13,691	539
1962	2,479	160	9,382	169	14,213	475
1963	2,682	154	11,562	240	16,314	531
1964	556	58	16,435	332	18,710	511
1965	840	81	18,620	308	21,234	512
1966	523	54	19,026	451	21,735	680
1967	1,819	101	17,010	399	20,896	624

Source: Lyles, C.H., Historical Statistics - The Squid Industry, U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, C.F.S. No. 4833, H.S. No. 14, Washington, November 1968, pp. 8-10

If new products are to be introduced, and demand for squid heightened, a reliable resource of squid is mandatory. Although there are really no authentic measures of the potential of the world's squid, the total is believed by experts to be enormous. The potential resource of squid off the coasts of the United States is of particular interest to this study. Various experts have estimated the potential of the Northwest Atlantic to be particularly vast. Voss[8] says the potential in this region is 500 thousand tons per year (1 billion pounds per year). Other estimates are by Shapiro[9] of 250 to 450 million pounds per year, and Rathjen and Serchuk[10] of a minimum of 100 million pounds per year of just the Loligo species. Rathjen further contends that this is an extremely conservative estimate and that equal amounts of the Illex species can be found in this region. Gulland[11] estimates an equally large standing crop of squid off the California coast in the Northeast Pacific.

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8 Voss, Gilbert L., Cephalopod Resources of the World, Fisheries Circular No. 149, Food and Agriculture Organization of the United Nations, Rome, April 1973

9. Shapiro, Sidney, Our Changing Fisheries, United States Printing Office, Washington, 1971

10. Rathjen, W.F. and Serchuk, F.M., Aspects of the Distribution and Abundance of the Long-finned squid, Loligo Pealii, between Cape Hatteras and Georges Bank, Laboratory Reference No. 73-3, N.M.S.F., Woods Hole, Massachusetts

11. Gulland, J.A., The Fish Resources of the Ocean, The Whitefriars Press Limited, London, 1971

To further emphasize the abundance of squid off the New England coast, the National Marine Fisheries Service, in its newsletter of January 11, 1973, estimated the Japanese catch of squid in the Northwest Atlantic for 1971 to be 15 thousand tons, and the Spanish catch to be 5 thousand tons. Both these amounts were accomplished with minimal effort and account for only a portion of the foreign landings in this area..

While estimates may vary, it is clear that the supply of squid off our shores is quite capable of meeting any conceivable domestic demand. With the question of availability cleared, the problem in the marketing of squid is in the establishment of a demand for this vast resource.

C. FISHING TECHNIQUES

An interesting array of fishing techniques and equipment has been utilized in fishing for squid. The Japanese , the world's most experienced squid fishermen, use three methods:

1) Line jigging

2) Automatic mechanized jigging

3) Trawl nets

Line jigging is the traditional method for catching

squid. This method, as used by the Japanese, calls for 35 fishermen to jig off the sides of a boat on separate lines. It is estimated that 600 pounds of squid can be caught per hour using this method.[12] Individual line jigging is also the technique employed by the Newfoundland squid fishery.

The Japanese have recently employed an automatic jigging device. This bit of apparatus simply replaces the role of the individual fisherman in the jigging process. The device can be run by a single operator, and yields of up to 2 tons per hour have been realized.[13]

In their fishing ventures off the east coast of the United States, the Japanese have found trawling to be another profitable method for fishing squid. Recent research voyages conducted by the National Marine Fisheries Service - Gloucester, have proven the trawling method to be successful in catching squid. These voyages were able to land about 4 tons of squid a day. Larger foreign vessels employing trawling equipment are believed to be able to land 5 to 10 tons a day.[14]

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12 Telephone interview with Susumu Kato, National Marine Fisheries Service, Tiburon, California, August 28, 1973

13 Ibid.

14 Personal interview with Warren F. Rathjen, National Marine Fisheries Service, Gloucester, Massachusetts, February 8, 1974

The successful use of trawling equipment for the capture of squid is of great importance to the potential establishment of a New England squid fishery. Since a majority of the equipment used by New England fishermen is trawls, the establishment of an east coast squid fishery would not necessitate new equipment development or rerigging of existing gear. Trawling equipment is relatively inexpensive and thus well suited for the small New England type of fishing operation.

Due to the nature of the ocean's floor off the California coast, trawling is impractical. The most popular gear used by the west coast squid fishery are the purse seine, lampara (meaning lightening, and used to catch fast moving fish) nets and brail nets. Both purse seines and lampara nets can yield 5 to 10 tons per hour with the aid of 7 to 10 fishermen.[15] Brail nets yield 2 to 3 tons per hour, but require only 3 fishermen to operate them.[16]

When nets are employed, almost all squid fishing is done at night. This is because large schools of squid can be effectively attracted to the fishing boats by shining flood lights over the water. Also, certain squid species

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15 Same as footnote #12.

16 Ibid.

17 Same as footnote #14.

give off a luminous substance. This aids the fishermen in detecting large concentrations of squid. However, the use of floodlights is prohibited in Monterey Bay (the center of the west coast squid fishery). While the official reason given is the ecological damage caused by the lights, the true reason is that the fishermen's union is attempting to bar new competition in the squid fishing field.

Several new and interesting techniques are being developed which could lead to vastly more economical methods of fishing for squid. Of these, the most promising seems to be the squid slurp, or pump. Research on the west coast has shown that squid can be effectively pumped directly on board a fishing vessel. When used in combination with flood lights, yields have reached 10 tons per hour.[17] However, the squid is a delicate creature and there is much concern over the pump's tendency to bruise the squid; especially for the larger east coast species. Work is being done to minimize this effect by altering the intake aperature diameter depending on the size of the squid sought. The Japanese have been working with echo sounding equipment for better fish detection, while American fishermen are working on aerial detection techniques using special photographic methods. Finally, some interesting possibilities in the

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17 Rathjen, Warren F., "Northwest Atlantic Squids", Marine Fisheries Review, Vol.35,No.12, December 1973, p.25

aquaculture harvesting area exist because of the short life span and maturation period of the squid.

D. PRICES

One of the basic assumptions at the outset of the M.I.T. study was that squid could be caught and sold at a lower price relative to other fish species used for human consumption. However, the entire question of price is unclear due to the infant status of the squid fishery in the United States.

The fishing industry is one of the most purely competitive industries from an economic perspective. Supply and demand factors directly affect the final price for a seafood commodity. Since domestic squid fishing has been a haphazard affair thus far, large supply fluctuations have led to large fluctuations in the price of squid. For example, the price of fresh squid at New York's Fulton Fish Market ranged from 25¢ to 80¢ per pound during 1972.[18] Fluctuations in squid prices have also occurred because of the seasonal nature of squid landings.

Another difficulty in tabulating price figures for squid, is due to the nature of the species. The quality of

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18 National Marine Fisheries Service Market Newsletter figures.

squid seems to vary directly with the size of the individual creature. Thus, large sized species have commanded a premium price over the smaller ones. In Monterey fishermen have recently been receiving $110 per ton for large squid, while obtaining only $35 per ton for the smaller ones.[19] Generally, the larger squid are frozen for domestic sale while the smaller varieties are minced and canned for export.

Any prediction of the future price for squid is hazardous. The one major unanswered variable is the future effort American fishermen will give to catching squid. However, two interesting trends have been noticed:

1) Over the past two or three years the average price for squid has increased dramatically. Monterey fishermen, who were netting 2¢ per pound in 1971, have been receiving 5¢ per pound in 1973.[20]

2) The foreign market (Europe) has had a price well above the average American price. The price for squid has also increased dramatically in Europe, with Japanese caught squid (off the New England coast) selling for $500-$650 per ton (25¢-37¢per pound).[21]

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19 Same as footnote #12.

20 Ibid.

21 Food and Agriculture Organization of the United Nations, Marketing of Fresh and Frozen Fish in Mediterranean Countries, Rome 1973

In Europe, The Illex species is thought of as an inferior product (connotation as bait) and sells for 20¢-30¢ per pound.[22] The Loligo species has approximately a 10¢ per pound premium price.[23] In all cases, the ranges in price are due to the size of the individual creature in the catch.

If this trend towards higher prices continues, it poses some serious questions as to the marketability of squid in the United States, and to the viability of squid as a source of a low cost high-protein concentrate.

E. INTERNATIONAL TRADE

Figures on the international trading of squid are poor (FAO, United Nations) since categories are not finely broken down, and squid is placed under the broader category of mollusks. It is believed that the major routes of trade are from the South Koreans to the Japanese, and the Japanese to Europe.

The U.S. exports squid on a limited basis. Annually we export about 10 million pounds, about half the U.S. catch. The exported product is minced canned squid. All of

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22 Interview with James Ackert, The Gorton's Corporation, Gloucester, Massachusetts, February 8, 1974

23 Ibid.

the U.S. export originates from California. Table 4-2 shows the U.S. export for 1972.

Table 4-2

U.S. Exports of Squid - canned, 1972

Destination	Quantity (lbs.)	Value ($)
Canada	119,009	12,955
West Germany	191,745	21,969
Greece	4,972,115	687,272
Philippines	4,858,738	638,563
Australia	130,953	15,749
Other	287,505	34,231
Total	10,560,068	1,410,739

Source: U.S. Department of Commerce figures, schedule B, commodity # - 0320220

The average price for U.S. exported squid is currently 13.4¢ per pound. The European market price for frozen whole squid is approximately 35¢ per pound.[24] However, due to the small size of the California squid, it is unlikely that Europeans would buy this species.

The question for this study seems obvious. Is there an export market for the vast squid resource which exists off the eastern coast of the United States? The

24 Same as footnote #21.

answer seems: yes!

While it is impossible to predict the future demand from the European market, three factors point in favor of my conclusion:

1) The price of imported squid, on the European market, has risen dramatically over the past five years. In Italy for example, the price for squid had risen faster than for any other seafood product.[25]

2) Foreign nations have made an increasing effort to land squid off the New England coast. The National Marine Fisheries Service estimated that in 1971 the Japanese landed 15,000 tons of squid in the Northwest Atlantic.[26] The Spanish effort in this region has grown,. It is estimated that 40,000 tons of squid may be taken in by foreign vessels in the Northwest Atlantic in 1974.[27] This entire catch will be bound for the European market.

3) Recent monetary realignments have worked in favor of U.S. exports.

While the potential export of squid would be closely related to the success or failure of other fish

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25 Ibid.

26 National Marine Fisheries Service Newsletter, January 11, 1972

27 Same as footnote #14.

species, one expert on the international market says that a U.S. export of 10 to 20 million pounds per year would be quite easy to obtain[28], while a Boston based fish exporter stated that the potential for squid exports is virtually limitless and he could "export all I can get."[29]

The large Japanese market, closed for years to foreigners, has recently allowed squid to be imported from other countries. In 1972 a large amount of squid was requested from the squid fisheries of California and New England.[30]

A few New England firms have just begun exporting squid to Europe. However, the level of this trade can be considered minimal when compared to the existing potential.

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28 Same as footnote #22.

29 Interview with Sidney Cohen, President, Sea-Mart, Boston, Massachusetts, October 11, 1973.

30 Boston Globe, "Japan to import Squid from N.E., Herring possibility", September 12, 1972.

Chapter 5 - M.I.T. Product Development[1]

A. PROCESSED SQUID PRODUCTS

With the basic assumptions toward product development strategy in mind, the decision was made by the staff of the Department of Nutrition and Food Sciences, M.I.T - Sea Grant, to develop the following products:

Product	Method of Preservation	End use	Accepted similiar product
Breaded rings	Freezing	Fried snacks and entrees	Clam strips
Chunks	Heat Processing (canning)	Seafood cocktail	Oyster, shrimp
Minced squid	Heat Processing (canning)	Chowders	Minced clams
Fillets and blocks (plain or breaded)	Freezing	Fried and baked entrees "fish" sticks	Finned fish fillets & blocks

The breaded rings were prepared in two forms. The first was pre-fried thoroughly and thus requires only oven heating before consumption, while the second was only slightly fried before freezing for preservation.

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1 This chapter is based largely on the work of Professor Zeki Berk. The material in this chapter is a brief summary of the facts laid out in Professor Berk's report, "Processing Squid for Food", M.I.T. Sea Grant Program, Report #MITSG 74-13, M.I.T., Cambridge, Massachusetts, February 15, 1974.

This second form requires additional frying, in oil, before suitable for consumption.

Professor Berk was successful in preparing the breaded rings, chunks, and minced form of squid. However, problems regarding the binding of "fish" stick forms and the curling of fillet forms when fried proved insurmountable. While a fillet or "fish" stick form of squid might be interesting from a consumer's point of view, the nature of the squid flesh may prove these forms to be impossible to prepare. Further research, employing extrusion methods, is called for.

Actual product concept testing was therefore carried out using the breaded rings, chunks and minced squid forms. The chunks were used as the base for a seafood cocktail, while the minced squid was used as the base for a seafood, or squid chowder. One can think of many interesting uses for both the chunks and minced squid product forms.

Preparation of all three product forms is quite simple and conforms to the seafood industry standards. Appendix A contains detailed information on the processing procedures and the recipes used for the processed squid products.

B. MECHANICAL EVISCERATION

The normal procedure for preparing squid calls for the removal of a thin layer of outer skin, and the removal of the internal viscera. This process has, up until now, been done by hand, and is a labor-consuming procedure. If attempts to introduce processed squid products to the domestic market are successful, an improved method of skinning and evisceration is called for.

Work by Professor Berk on a mechanized process has proven successful in cleaning squid. The apparatus employs spring loaded rollers which squeeze out the viscera as the squid passes through the mechanism. A prototype device has been constructed which has successfully cleaned squid in the laboratory. While further development is necessary to install such equipment in an actual seafood processing plant, the extra investment needed in research and development is believed to be small. A patent has been filed covering the principle of the operation and the mechanized device.

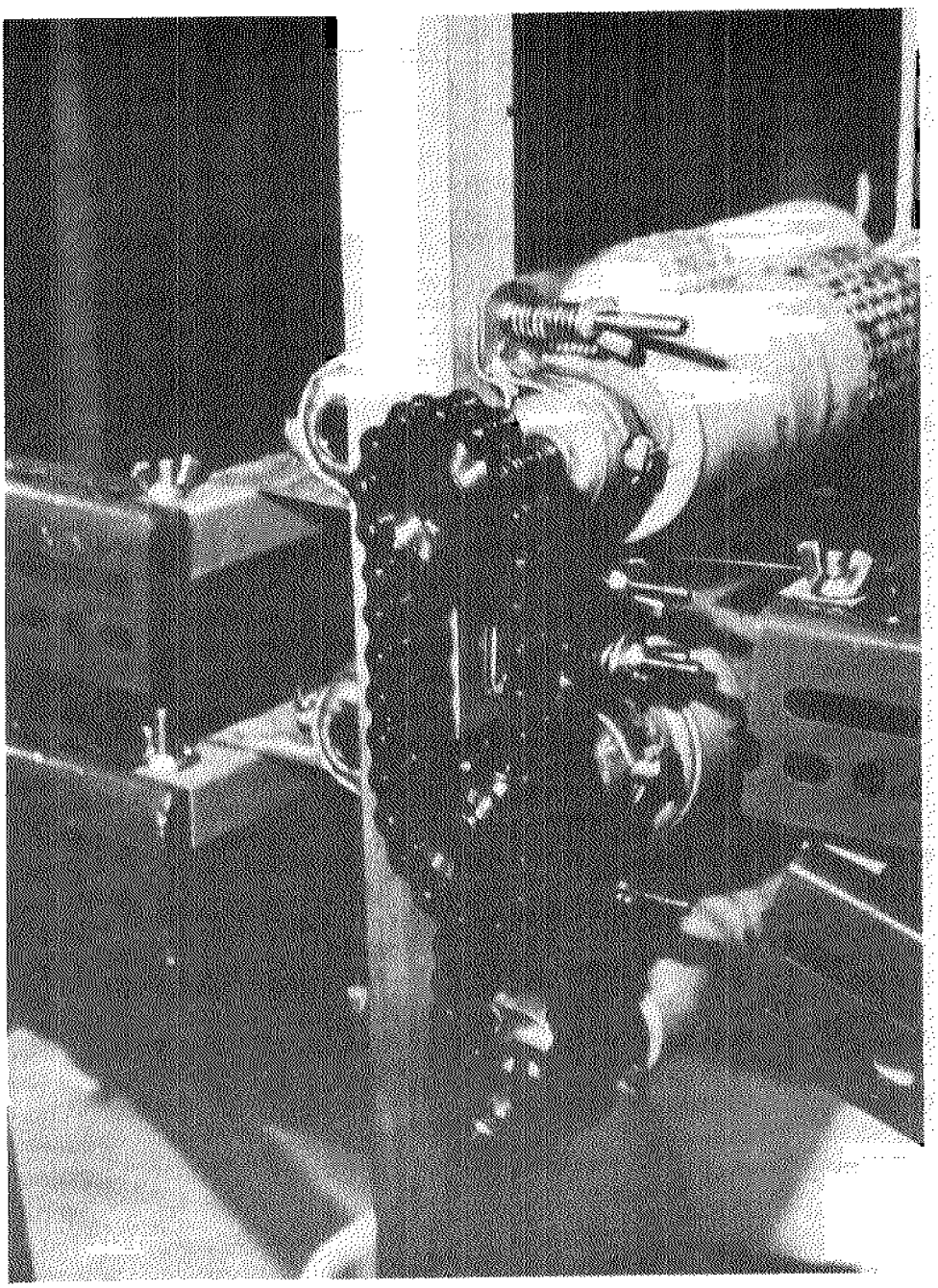
Professor Berk has supplied me with his estimates of the investment and production costs necessary to process the squid products using the automatic equipment. These figures are shown in Appendix B. It should be noted that these figures are in line with the current production

of other processed seafood products.

The Berk apparatus is shown in Illustration 5-1.

Illustration 5-1

Berk Squid Cleaning Apparatus



Chapter 6 - Market Research

A. TELEPHONE INTERVIEW SURVEY

In order to gain insight and a feeling for the general population's attitudes and impressions towards squid, a telephone interview survey was conducted. The survey was aimed at gaining knowledge of the awareness, attitude, and prior eating experience of squid for the Boston area consumer.

The survey was initially constructed to take the form of a personal interview survey, with shoppers being interviewed in the parking areas of large shopping centers. Unfortunately, this technique proved to be very time consuming, in that few shoppers were willing to stop and take the five minutes required to complete the interview. Therefore, a telephone type survey was judged to be more desirable, in that a greater number of respondents could be tabulated in a shorter time period.

The telephone survey was conducted during July and August of 1973. Names were randomly selected and dialed from the Boston telephone directory; thus the population sampled included Boston, Brookline, Cambridge and Somerville residents. Although attempts were made to phone during all hours of the day, the majority of calls were from 1 p.m. to 4 p.m. This naturally led to a predominance

of female respondents (actual sample showed 80% female, 20% male). A total of 132 completed interviews were collected. The questionnaire form is shown in Exhibit 6-1.

The method of sampling was a systematic drawing from the telephone directory. If a number dialed did not answer, no further attempt to dial that number was made. However, if a busy signal was heard, the same number was tried again after five minutes. Once a call was answered, I introduced myself as an M.I.T. graduate student doing research on Boston area consumer food habits. Most people were very helpful and eager to complete the short interview. From recollection, my estimate of those unwilling to be interviewed was less than 10%.

The respondent was asked questions 1 through 6 on the interview form. I filled in the sex of the respondent and noted the last name and location, as listed in the phone directory. Locations were broken down into sections of Boston such as Hyde Park or Roxbury. This geographical breakdown was used as an aid in identifying the ethnic breakdown of the population sampled.

The results of the survey showed that 64% of the sample had heard of or knew what squid is, while only 11% had heard of calamari (the Italian name for squid). 16% of those sampled had eaten squid before. However, of the 21 respondents who had eaten squid previously, most

SQUID QUESTIONNAIRE -- Telephone

1) Have you every heard of squid? Yes / / No / /

1a) What is squid? _____

2) Have you ever heard of calamari? Yes/ / No / /

2a) What is calamari?_____

EXPLANATION

3) Have you ever eaten squid?

Yes / /

3a) Where? Home / /
Restaurant / /
Other_____

_____

3b) When was the last time you ate squid?

_____

3c) Approximately, how often do you eat squid?

_____

No / /

3a) Why not?_____

_____

3b) Would you ever buy a squid product from a supermarket if you saw it on the shelves?

Yes / / No / /

Why not?_____

_____

3c) If you saw a squid dish on a restaurant menu, would you try it?

Yes / / No / /

Why not?_____

_____

4) Do you have a general attitude or feeling about squid?

Yes / / No / / What is it?_____

_____

5) Approximately, how many times a week do you eat fish?_____

6) Are you the major food shopper in your household? Yes / / No / /

Sex M / / F / / Age_____

Location or Adress _____

Name (telephone only)_____

Exhibit 6-1

said it was tried only once, or eaten very rarely. Those having previously eaten squid had had it at home, in a restaurant, or on a trip to Spain or Greece.

When asked what squid was, or when asked for a general attitude towards squid, the responses broke down as shown in Table 6-1.

Table 6-1

Squid Comments - Telephone Survey

Comment	Frequency
Fish	59
Don't like the looks of it	17
Octopus	16
Slimy - yuky - iky	7
Don't like the sound of it	6
Doesn't appeal to me	6
Seafood	4
Italian delicacy	2
Tough	2
Liked taste of it	1
Eel	1
Anchovies	1
Snail	1

On the 64% of respondents who had heard of squid before, an attempt was made to classify their attitudes towards the purchase of squid as either: positive, neutral or negative. In some cases, respondents made statements which clearly classified their attitudes. However, due to the brief nature of the interview, an accurate classification was difficult in many cases. If a respondent had previously eaten squid and mentioned nothing unfavorable about it, he was classified as being positively disposed. Similarly, if a respondent answered YES to either question 3b or 3c he was rated as being positive. If a respondent answered NO to both 3b and 3c but made no further negative statement about squid, he was rated as neutral. A respondent was rated as negative only if he gave clearly negative statements concerning squid. It is clear that this system of classification is biased in favor of more positive ratings. However, it is used for simplicity, and care must be taken in drawing any conclusions from it.

Of the 85 respondents classified, 24 were rated as positive, 15 as neutral, and 46 as negative. In viewing the entire sample of 132 respondents, only 18% could be classified as being favorably disposed to squid as a source of food. Due to the positive attitude bias in the classification system, this is viewed as a very poor

percentage.

In addition, moderate geographic correlations were found. Respondents from Cambridge, South Boston, and Somerville (all heavily Italian) tended to have a greater awareness and familiarity with squid than respondents from Brookline (heavily Jewish) and Roxbury (heavily Black).

B. TASTE PANEL TEST

To test the acceptability of our three product forms, namely squid chowder, fried squid rings, and squid cocktail, a taste panel of 56 people (29 female, 27 male) was asked to taste our three products and complete a simple questionnaire - a copy of which is shown in Exhibit 6-2. The tasters were aware of the fact that the products were made from squid. They were asked to rate each product with regard to its general acceptance, taste, texture, and appearance.

The results were quite favorable. With the exception of the appearance of the cocktail and the texture of the fried rings, all products rated high in all categories. The squid chowder product tested particularly positive; receiving a 4.28 score out of a possible 5.0 on general acceptability. A graphical summary of the test's results is shown in Exhibit 6-3. In subsequent, informal taste situations, the texture of the fried rings proved to be

Squid Taste Test - Questionnaire

We are testing the market acceptability of various squid processed food products. Please give us your opinion of each product after you try it.

Name _____ Date _____

Product - _____

General Acceptance - 1 Dislike very much / /
2 Dislike / /
3 Neutral / /
4 Like / /
5 Like very much / /

Using the same scale as above, rate the product in the following categories:

Taste -	Texture -	Appearance -
1 / /	1 / /	1 / /
2 / /	2 / /	2 / /
3 / /	3 / /	3 / /
4 / /	4 / /	4 / /
5 / /	5 / /	5 / /

Where would you expect to find this product? (supermarket, restaurant, quick-food chain, etc.)

_____

How much would you expect to pay for a portion of this product?

_____

Please give any comments on how you believe that this product could be improved.

_____

_____

_____

Exhibit 6-2

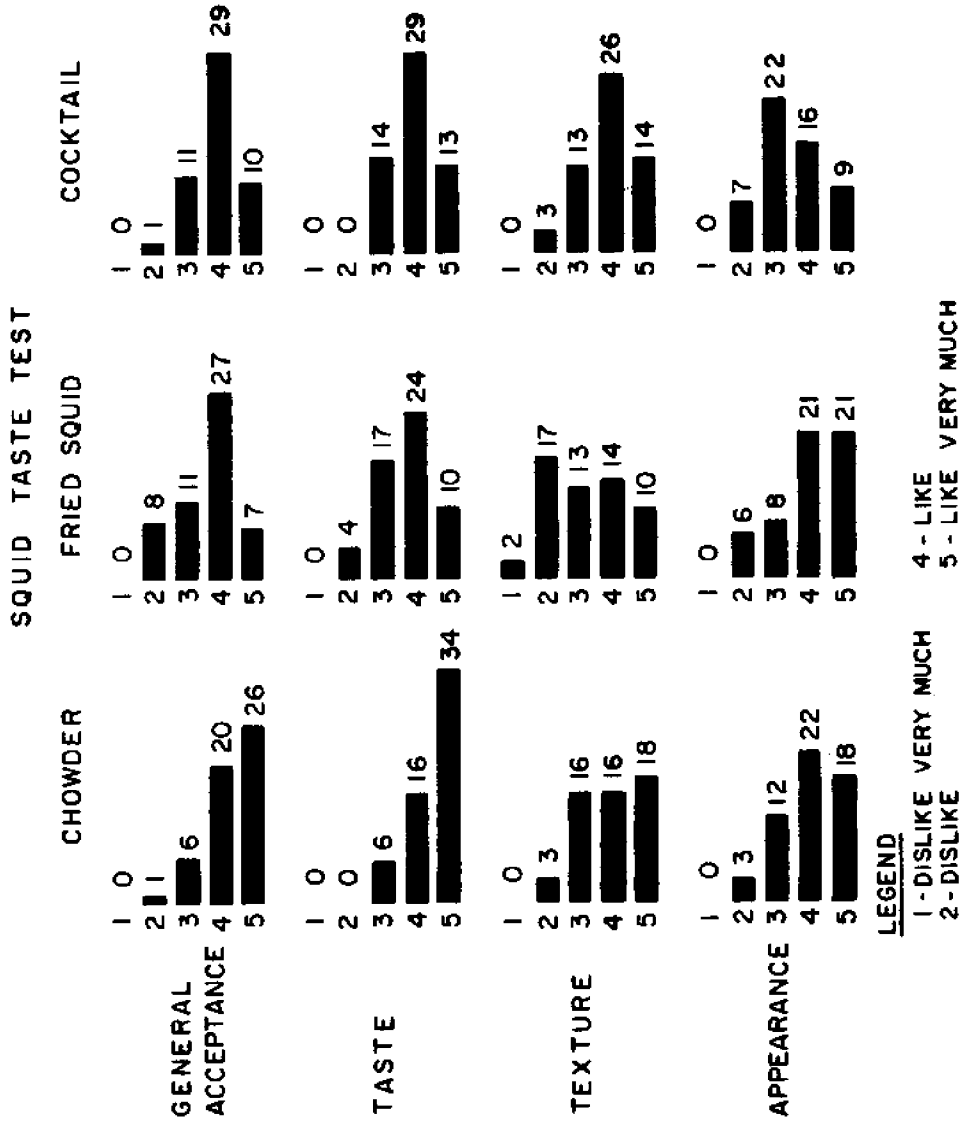

SQUID TASTE TEST
CHOWDER
FRIED SQUID
COCKTAIL
GENERAL ACCEPTANCE
TASTE
TEXTURE
APPEARANCE
1 0
2 1 8 0
3 6 11 11
4 20 27 29
5 26 7 10
2 4
3 6 17 14
4 16 24 29
5 34 10 13
2 3
3 16 13 13
4 16 14 26
5 18 10 14
2 6 7
3 12 8 22
4 22 21 16
5 18 21 9
LEGEND
1-DISLIKE VERY MUCH
2-DISLIKE
3-NEUTRAL
4-LIKE
5-LIKE VERY MUCH

Exhibit 6-3

less of a problem.

In completing the questionnaire, the respondents gave some very helpful comments concerning the products tested. Table 6-2 lists these remarks and their frequency.

While the tasters in this test formed a biased sample (all were willing to eat squid), the results show that, in fact, we are dealing with products that have the potential of gaining consumer acceptance.

C. MAIL QUESTIONNAIRE SURVEY

The very promising results of the taste test panel indicate that the three processed squid products have a rather high potential for repeat purchase. Considering just the actual physical product (price, packaging, and other marketing variables omitted), once someone has tried the product, it is likely he will try it again. The next question for the marketer is : what initial or trial purchase rate can be expected for these products? An attempt at estimating this rate was undertaken in the form of a mail questionnaire survey.

In trying to construct an instrument to estimate trial purchase, an attempt was made to simulate the shopping experience as closely as possible. Due to the nature of the food industry, it was felt that even if

Table 6-2

Remarks from Tasters from Taste Panel Test

Comment	Frequency
CHOWDER	
Could be thicker	8
Use larger pieces of squid	6
Needs slight taste improvement	4
More spicing up	3
More vegetables	2
Muddy color	2
Use more squid	2
Use lemon juice	2
Use salt	1
Less potatos	1
Too much squid	1
COCKTAIL	
Use larger pieces of squid	9
Too soft	7
Not enough taste	6
Improve color	1
Change sauce	1
Mix with other fish	1
Use ice	1
Cut differently	1
Fishy odor	1
Use tartar sauce	1
Improve texture	1
Use lemon	1
Black spots	1
FRIED RINGS	
Dislike breading (too much)	26
Too tough	17
Too oily	7
No flavor	6
Clean fish better	4
Fry longer	3
More salt	3
Cut into finer strips	2

Table 6-2 (continued)

Spicier	2
Use tartar sauce	2
Cut into straight strips	1
Hard to handle	1

introduced, squid products would not command much advertising support. Shelf space allotment, price, and packaging would be the prime discretionary marketing variables used in selling these products. The model thus becomes:

AWARENESS ——→ ATTITUDE ——→ TRIAL PURCHASE

Factors other than attitude will affect trial purchase. For the purposes of this study these factors were broken down into three categories: PRICE, PACKAGING & LABELLING, and DEMOGRAPHICS.

Due to time and financial constraints a mail interview survey seemed optimal. I was fully aware of the problems involved with such a technique. However, it was the most efficient way to obtain the large number of responses needed, and was within our financial means.

One of the prime difficulties of a mail survey is the problem of non-response bias. Bias occurs because interested participants are more likely to respond than uninterested ones. In an attempt to minimize this problem, the respondent was brought into the questionnaire believing it was concerned with the general topic of food, a topic of interest to most people. More will be said about non-response bias later.

The basic thrust behind the questionnaire (a copy of which is found in Appendix C) was to obtain two crucial

measures from the sampled population. First a measure of trial purchase, and second a measure of the respondent's attitude towards squid. To obtain a trial purchase measure the respondent was asked to mentally place himself into a grocery shopping situation. He was then asked to choose three items from a list of eight possibilities. This was done for both soups and lunchtime entrees. In each case, one squid dish was listed among the eight possibilities. In order to simulate the shopping experience as closely as possible, an ingredients listing, for all products, was included on the back of the questionnaire form. Furthermore, by systematically varying the price and labelling of the squid product on each list, I hoped to see what effects alternate pricing and labelling strategy would have on trial purchase.

The sample population was randomly divided into three sets of 150 people. The first set received a shopping list with the name SQUID on the front (label), with the price of the squid product being equal to that of the clam product. The second set of people received a questionnaire form where the word SEAFOOD replaced the word SQUID in identifying the product. However, the word SQUID was still used in the ingredients listing. The price of the squid product was again equal to that of the clam product on the list. The third set once again had the

word SEAFOOD on the label. However, the squid (or seafood) product on this list would sell for less than the substitute clam product. In the case of the chowder, the price dropped from 35¢ to 29¢ per can, while for the fried ring product the price was dropped from 67¢ to 63¢.

The second major section of the questionnaire was designed to measure the respondent's attitude towards squid. A combined Thurstone-Likert approach was employed.[1] I initially accumulated 25 statements concerning squid, then asked a group of judges (graduate students) to rate the positive or negative connotation (+5 to -5) associated with each statement. A total of 10 completed sets of judgments was obtained. Using Thurstone scaling methods, statements that judged out to a high variance were discarded and the remaining statements were scaled according to the median of the judged responses. A final list of nine attitude statements was obtained and scaled as follows:

Eat squid, you've got to be kidding.	-3.5
I'd probably feel sick if I ate squid.	-4.0
Lots of people like squid.	+2.5

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1 For a detailed description of this technique see: Oppenheim, A.N., Questionnaire Design and Attitude Measurement, Basic Books, Inc., New York, 1966, pp.125-42

Squid is a low calorie food, therefore is good for diets.	+3.0
Squid is very hard to find.	+0.5
I wouldn't eat squid if you gave me 5 dollars.	-3.0
I wouldn't eat squid if you gave me 100 dollars.	-5.0
Squid stays fresh for a long time.	+2.0
Squid is healthy to eat.	+3.5

The questionnaire respondents were asked to either AGREE STRONGLY, AGREE, NEUTRAL, DISAGREE or DISAGREE STRONGLY with each of the statements on the list. A Likert weighting system of AGREE STRONGLY=5, AGREE=4, ... DISAGREE STRONGLY =1 was used for the analysis. By multiplying the Likert weights times the Thurstone statement scale values, and summing over all nine statements, an interval scaled value was obtained which gave a measure of the respondent's attitude towards squid.

If a respondent answered NEUTRAL to all nine statements he would have received a value of -12. Thus, in an attempt to clarify the scaled attitude results, +12 was added to the score of each respondent. Since this procedure produces an interval scaled value for attitude estimation, a linear transformation is perfectly

acceptable. In this way, a score of zero indicated a neutral attitude, while positive and negative scores each reflected themselves equally. In other words, a score of +10 was judged as being as positive as a score of -10 was negative.

Believing that the appearance of squid, in its natural form, has created a negative attitude among many people, a pleasing photograph of prepared squid rings was included just before the attitude statements in half the questionnaires sent out. This photo concept may be thought of as being analogous to the type of photo depicted on many frozen seafood packages. By varying the insertion of this photo I hoped to determine whether or not it had any effect on the respondent's attitude towards squid.

In addition, various demographic characteristics were called for in the questionnaire. A total of 450 questionnaires were mailed out. The sample was randomly selected from the Boston area telephone directory which includes the residents of Boston, Brookline, Cambridge, and Somerville.

Upon receiving responses, my first problem was deciphering some confused answers. In many cases certain questions were left blank or only partially completed. While a few respondents were confused by the shopping

lists, I could usually determine whether a person wished to purchase the squid product on the list. Likewise, in many completed questionnaires, a respondent did not complete all nine attitude statements. In cases where only one or two were left blank, that respondent was assumed to have a rating of NEUTRAL for those blank statements.

The response rate can be summarized as follows:

	#sent	#deliv.*	#resp.	%resp.
PICTURE-SQUID label-equal price	75	69	17	25
PICTURE-SEAFOOD label-equal price	75	68	20	29
PICTURE-SEAFOOD label-lower price	75	70	21	30
NO PICTURE-SQUID label-equal price	75	70	34	49
NO PICTURE-SEAFOOD label-equal price	75	71	22	31
NO PICTURE-SEAFOOD label-lower.price	75	67	18	32
TOTAL	450	416	132	32

* No deliveries due to change of address or address unknown.

I initially intended to check for non-response bias by comparing the level of awareness of the respondents in the mail questionnaire survey against the level of awareness of the respondents in the telephone interview survey (Chapter 6, Section 1). The level of awareness for

the former was expected to be higher than the level of awareness for the latter due to the effect of non-response bias. Supposedly, people who were not aware of squid would be less interested in the survey and decide not to fill it out, or some unaware people would be embarrassed by their lack of knowledge and decide not to return the form. However, while tabulating the awareness rate for the mail survey's respondents, I noticed some very technical and accurate descriptions of squid. I concluded that many unaware respondents, instead of not returning the questionnaire, simply looked up the word in a dictionary, and filled out and returned the questionnaire form, thus invalidating the awareness measure. I then turned to the level of previous squid consumption as an indicator of non-response bias. The telephone survey showed previous consumption to be around 16%. The mail survey showed it to be at 38%. The difference in percentages is clear, and therefore shows that non-response bias has clearly affected the mail survey results. Thus, the mail survey respondents do not form a random sample of Boston area consumers, but are biased in the direction of heavy squid orientation.

Of the 132 responses, only 15 people (11.4%) wished to purchase a squid product. Eight (6.06%) wished to purchase the rings, while eight (6.06%) wished to

purchase the chowder product.* If one wishes to extrapolate these results to the total population, the effect of non-response bias must be accounted for. Therefore, as a second-hand estimate of the trial rate, one could estimate that only 8 people out of 416 (total questionnaires delivered) would be willing to try either fried squid rings or the squid chowder. The thinking here goes as follows: if someone would wish to purchase a squid product he would probably be motivated enough to fill out and return the questionnaire form. If this is true, it would indicate a trial rate of only 1.92%. The actual statistic must lie somewhere between 1.92% and 6.06%. However, it is likely that it falls closer to the first figure. This researcher is well aware of the fact that this experiment has measured the first time period trial rate. If the same respondents were asked to fill out the questionnaire every week for a year, it is clear that the total trial would increase somewhat. Whatever the case though, the trial rate indicated from this survey is considered to be extremely low. Table 6-3 shows the number of respondents wishing to purchase the products on the simulated shopping list. The actual number of simulated purchases is higher than shown in Table 6-3

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* One respondent chose both the chowder and the fried ring product.

Table 6-3

Number of Simulated Purchases by Product - Mail Questionnaire Survey

SOUPS	ENTREES
Cream of Chicken - 32	Beef Stew - 40
Clam Chowder - 49	Fried Clams - 29
Oyster Stew - 18	Cheese Ravioli - 44
Tomato - 73	Sea Scallops - 30
Squid Chowder - 8	Squid Rings - 8
Cream of Shrimp - 24	Macaroni & Cheese - 58
Cream of Mushroom - 61	Spaghetti & Meatballs - 66
Minestrone - 55	Chicken TV Dinner - 46

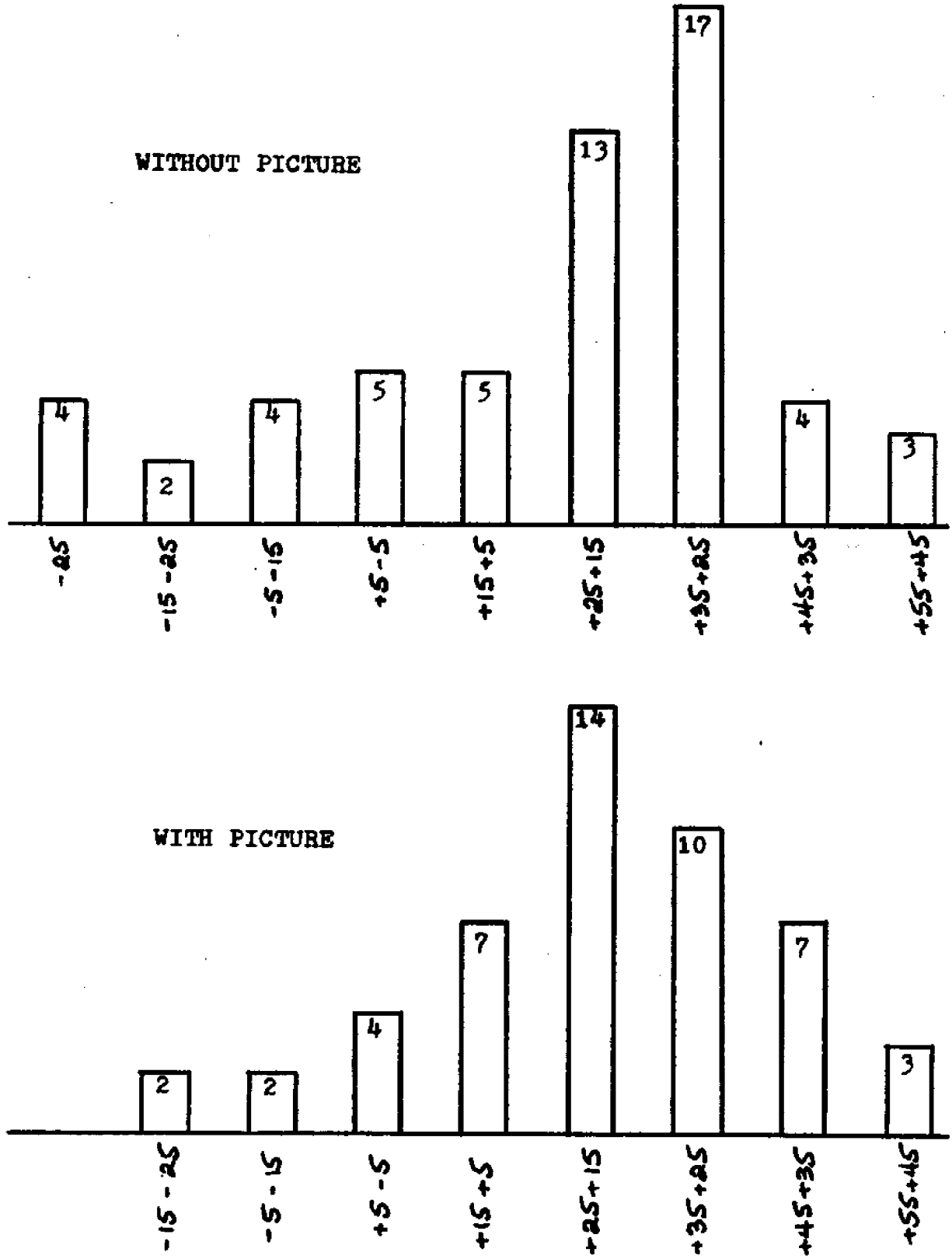
since a purchase of three cans of tomato soup is listed as a single respondent purchase in Table 6-3.

Unfortunately, the number of responses was too small to do any kind of Chi-square analysis to statistically measure whether price or labelling had any effect on trial purchase. However, it is interesting to note that 13 out of 15 squid purchasers were not presented with the name SQUID on the label. Also, in checking the previous consumption and trial purchase rates of squid along demographic lines, I observed no difference by sex (PURCHASE, males=11%, females=12%, PREVIOUS CONSUMPTION, males=41%, females=36%). Squid buyers also tended to come from the middle income categories: 13 out of 15 buyers of squid were from the second and third income categories as denoted on the questionnaire form.

I next tried to determine whether or not the insertion of a picture had any effect on the attitude score of the respondents. Exhibit 6-4 shows a histogram of attitude scores for the picture and no-picture cases. The no-picture case had a mean attitude score of 15.8 with a variance of 21.9, while the group which had a picture inserted in their questionnaire forms had a mean of 20.1 with a variance of 16.0. A Chi-square analysis indicates that these two distributions are different at only the .15 level of significance. If the strong

Exhibit 6-4

Histogram of Attitude Scores



assumption that the distributions are normally distributed is made, an analysis of the difference of means shows that the difference is significant at almost any level. The appropriate calculations are included in Appendix C. However, upon viewing the histograms, much of the difference seems to be caused by a larger number of very negatively disposed respondents of the no-picture case. While the insertion of a picture may have had an effect towards improving attitudes towards squid, this effect is clearly very small.

If a respondent had answered NEUTRAL to all nine attitude statements, he would have received an attitude score of zero. It is therefore interesting to note that for the group not receiving a picture, 75% had positive attitude scores. This percentage was even higher for the group that did receive a picture. Even taking the problem of non-response bias into account, this seems to be a very high percentage of positive attitudes.

The final stage of the analysis was an attempt to determine what factors were important in a respondent's decision to purchase a squid product. The sample was grouped into two sets: purchasers of squid products and non-purchasers. For this stage of the analysis, only respondents who were not given a picture of fried squid rings were used. Since the picture was placed between the

trial purchase and the attitude measurement sections of the questionnaire, the presence of the picture would contaminate the intended purchase vs. attitude analysis. The Biomed Stepwise Discriminant Analysis, BMD07M, computer program was employed.

The first model used the naive hypothesis that attitude alone can discriminate buyers from non-buyers. While attitude and trial purchase were correlated in the same direction (higher attitude, higher intended purchase), the discriminant function was poor in predicting who buyers would be. The resulting function was able to properly classify only 28 of 53 people.

The next model of trial purchase used attitude score, average weekly fish consumption, past squid consumption (0,1), labelling (0,1 depending on whether the word SEAFOOD or SQUID was used to identify the product), and price (0,1 depending on whether the squid product was priced equally or below the clam product substitute). The use of 0,1 variables is not strictly allowed in a discriminant analysis. However, it was felt that their use would not disturb the results greatly.

Surprisingly, four independent variables were significant (F-statistics greater than 1.0) in determining the discriminant function. Furthermore, discriminant groupings were quite distinct (F-statistic was 2.0 for

the difference in the discriminant function group means).

The order in which the independent variables entered was:

1 - LABELLING

2 - ATTITUDE SCORE

3 - PREVIOUS SQUID CONSUMPTION

4 - PRICE

The magnitude of the importance of each factor can be determined by subtracting the corresponding coefficients of the two discriminant functions. The higher the absolute value of the difference, the more important that variable is in discriminating buyers from non-buyers. If this is done for all four independent variables, the result is that labelling (use of the word SEAFOOD vs. the word SQUID in identifying the product) plays the most important role in discriminating purchasers from non-purchasers. The resulting discriminant functions were able to properly classify 40 of 53 respondents.

D. INDUSTRY INTERVIEWS

As mentioned previously, the question of whether or not the consumer will accept squid is only one of many questions that must be answered. The reactions of processors, brokers, fishermen, etc., towards the domestic

introduction of processed squid products is vital. Thus, a major portion of my investigations was concerned with interviewing various members of the seafood marketing chain, and obtaining their attitudes towards squid and towards the three processed product forms.

In general, I would characterize their attitudes as being extremely negative. I would venture to say that people within the seafood industry were more negative towards the domestic introduction of squid, than the general consumer population. Many longtime seafood businessmen were quick to state that a successful introduction of a processed squid product form would be impossible. Most agreed that the name SQUID was the product's greatest detriment, and any attempt to introduce a new squid product must be accompanied with a change in name. This view is in agreement with the results of the mail questionnaire survey.

Many other suggestions were offered. The one which occurred most was the possibility of exporting squid to Europe. However, it seems clear that the processors interviewed would be hesitant to undertake the manufacture of squid in the forms I suggested to them. With the perceived low volume and the swift duplication available to competitors, the pioneering of squid products was viewed as being unfavorable from an economic perspective.

E. FROZEN CLEANED MANTLES

The American consumer buys from 10 to 20 million pounds of fresh or frozen uncleaned squid a year. As stated previously, most of this trade is directed at the urban ethnic markets, both household and restaurant. In the course of my investigations I began to wonder whether a frozen, but cleaned product might not be able to gain a competitive advantage over the existing uncleaned product. The cleaned product form would save the consumer the time required to skin and eviscerate the squid. This time saving would be considerable. Experienced squid handlers take around 70 seconds to clean a pound of Loligo, and up to 2 minutes to clean a pound of Illex.[1] The unskilled squid handler would obviously require more time. This added dimension of time savings and convenience may be especially attractive to the restaurant trade.

In my experience in preparing squid, I found the skinning and cleaning phase to be the least desirable. If my feelings are common to those "Italian housewives" who currently prepare squid for their families, then it is felt

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1 Estimates supplied by Vincent Ampola, National Marine Fisheries Service, Technical Laboratories, Gloucester, Massachusetts.

that the extra convenience of a cleaned form may induce these people to prepare squid more often. My hypothesis is that squid is eaten infrequently at home because of the long time it takes to prepare. In addition to potential increased frequency of purchase, a cleaned squid form could lead to an increase in the trial purchase rate. The cleaned form has a much more appealing appearance than the uncleaned form, which has tentacles, eyes, and head showing. Therefore, it is believed that the cleaned product form could command a larger market than the uncleaned form currently obtains, because of a higher trial purchase rate and a higher frequency of purchase.

One of the major reasons that squid packers have been reluctant to skin and clean the squid themselves has been the labor consuming aspect of this operation. The skinning and cleaning phase alone would add 4¢-8¢ a pound (depending on size and species) to the processor's cost. However, if a mechanized cleaning process were installed, the processor could skin and clean a pound of squid for less than a penny.[1]

However, the cleaned squid mantle product form does pose one problem which I have been unable to solve. Currently, frozen cleaned squid is sold in 3 or 5 pound packages at a price of around 60¢ per pound (the instability of squid

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1 Figure derived from cost estimates shown in Appendix B. Calculations were made for a production rate of 1 ton/hr.

prices has already been mentioned). While the convenience aspect of cleaned squid should command a small price premium over the uncleaned product, the actual price per pound figures would have to be drastically different. This is due to the actual yield figures for squid. The cleaned mantle comprises only 60% of the total body weight of a squid. Therefore, a housewife who currently buys three pounds of uncleaned squid, is actually buying only 1.8 pounds of mantles. It is unclear whether or not the housewife will be able to differentiate the weight advantages of a cleaned mantle product. Will she be willing to buy 1.8 pounds of cleaned mantles, as opposed to a 3 pound package of uncleaned squid? Actual package design and information content (stressing the cleaned aspect) will be crucial to a new cleaned product's success. However, products such as boned chicken and boneless steaks command a high premium over their unboned substitutes, while having gained consumer acceptance.

In addition to the cleaned frozen mantles, a processor would be able to export canned, minced squid obtained from the remaining edible sections of the squid (tentacles, fins).

Chapter 7 - Conclusions and Suggestions

A. PROCESSED SQUID PRODUCTS

The results from the taste panel test indicate that all three processed squid products (chowder, cocktail, and fried rings) have the potential of attaining a high level of repeat purchase. However, readings from the telephone interview survey and the mail questionnaire survey indicate that potential trial purchase will be extremely low. The fact that all market research was conducted in the Boston metropolitan area seems to compound the problem. The high seafood orientation of this area would indicate that results would be even poorer if research were conducted elsewhere.

A situation of high potential repeat purchase and low potential trial purchase is hardly uncommon to new products. The accepted strategy among marketers is to employ extensive promotion. Unfortunately, due to the nature of the seafood industry (many small and fragmented processors), it is believed that a squid product, even if introduced, would command very little promotional support.

Even if a large advertising campaign were undertaken, (possibly by the government) it is unclear whether it would be of much benefit. Once again, my model of trial purchase is:

AWARENESS ⟶ ATTITUDE ⟶ TRIAL PURCHASE

Advertising is most effective in changing the awareness of the population. Only very effective advertising, and large amounts of it, will change the attitudes of the population. Furthermore, in the case of squid, the required change is not from neutral to positive, but from negative to positive. Therefore, it is unlikely that even heavy advertising would be of much use.

The sales volume of a processed squid product would further be limited by the nature of its consumption. In talking with squid eaters on the telephone and in person, the impression I received was that squid is treated more as a delicacy than as a staple. This view coincides with the findings of the telephone interview survey.

It seems as if the name SQUID, and its connotation, is too tough an obstacle to overcome. The views of experienced seafood businessmen and the results of the mail questionnaire survey agree on this point. Even if the FDA were to allow a name change (an unlikely possibility), new stricter nutritional labelling requirements would still require the name SQUID to be included on the listing of ingredients.

The conclusion reached by this researcher is that the potential market for a processed squid product is too small to warrant introduction. The squid market is clearly too small for a large processor, and it is at best marginal

for a small seafood processor who might choose to concentrate his distribution to small groceries in urban ethnic areas.

B. POSSIBILITIES

The conclusion of not introducing a processed squid product onto the domestic market was reached because of the small potential for each of these products. The problem with a processed product is that it further segments the squid market; a market which is very small to begin with. A new product form, such as a frozen cleaned mantle, which covers the entire squid market, has a greater chance of success. With the development of mechanized squid cleaning apparatus, technology now allows such a product to be produced economically.

If the current trend of fish price hikes and supply shortages continues, the American consumer may have to rely on squid products to fill the gap. While the introduction of a processed squid product is unwarranted at present, future introduction may become necessary. The presence of a cleaned squid mantle on the market, with its pleasing appearance, could have a great effect in improving the public's attitude towards squid.

Of the three processed products tested, the only

product suited for future introduction is the fried rings. The squid chowder, which fared best on the taste panel test, simply wouldn't be worth the risk. So little fish or clam is used in a chowder, that the cost advantage of squid over clams would be minimal. As for the cocktail form, the market for this product form is in the restaurant trade. It seems to make little sense for the processor to handle an item which can easily be prepared by the restaurant; especially a low volume item such as squid cocktail. With the introduction of a cleaned mantle product, the preparation of squid cocktail would be trivial. The possibility of introducing the fried ring product form through the fast food service market should be investigated. If the price of squid remains low, it could serve as an excellent source of low cost protein. The advantage of the fast food service market is that the name SQUID might be able to be disguised.

The current price levels and demand for squid in Europe would indicate that the initiation of an organized squid fishery off the New England coast would be a profitable venture. In addition, such a move would serve as a first step in opening up the marketing channels of distribution necessary for future domestic introduction of processed squid products. The crucial first step of getting the fishermen to fish for squid would be accomplished. When and if demand warrants it, this source of squid could then

be diverted from export trade to domestic production.

At present the fishing nations of the world are negotiating the possibility of extending territorial fishing rights to a new 200 mile limit. While the outcome of these negotiations is uncertain, if territorial fishing waters are to be extended, it would further strengthen the conclusions reached so far. If foreign fishermen were not allowed to fish within 200 miles of the U.S. coast, then U.S. fishermen would be able to fish for all species at a new higher rate. If supplies of other species became ample, the necessity for squid on the domestic market would be reduced. Likewise, if a 200 mile limit were imposed, the foreign demand for squid would rapidly outstrip supply (a great deal of foreign squid fishing takes place within 200 miles of the U.S.) and cause foreign prices to escalate. Supply and demand factors would favor U.S. exports of squid at a heightened level.

C. FINAL SUGGESTIONS

1. The domestic introduction of processed squid products, in whatever form, is economically unwarranted at the present time.

2. The domestic introduction of a frozen cleaned mantle product seems justified. The cleaned product form should command a price premium over the existing frozen, but

uncleaned form. The exact nature of the price structure must be investigated.

3. The utilization of the Berk mechanical cleaning apparatus, for use with the frozen cleaned mantle form, seems justified at even low levels of demand.

4. Exploitaion of the European market should begin. The establishment of an east coast squid fishery, selling frozen uncleaned squid directly to Europe, is called for.

5. Continuing effort should be given to develop industrial squid products. Also, further market research to identify acceptable squid products for the domestic market is necessary. Research into the possible introduction of squid through the fast food service market is called for.

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APPENDIX

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Appendix A [1]

Processing of Squid Products

Breaded frozen rings

a. Cut off tentacles and fins.

b. Eviscerate by hand or using special machinery.

c. Wash in cold (12-15°C) running watter, to remove any dirt, ink or viscera adhering to the surface of the mantles.

d. Scald in hot water (60°C) for 2 minutes. This step facilitates the skinning operation.

e. Skin by hand or using special machinery.

f. Cut mantle transversely into uniform, circular rings.

g. Bread the rings -
   1) First dust with dry batter mix or flour.
   2) Dip in batter.
   3) Bread rings.

h. Rings for deep frying - Freeze for preservation.

h-1. Rings for oven heating - Oil blanch rings at 125°C for 2 minutes.

i. Freeze for preservation.

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1 Taken from: Berk, Zeki, "Processing Squid for Food", M.I.T. Sea-Grant Program. Report No. MITSG 74-13, Massachusetts Institute of Technology, Cambridge, Massachusetts, February 15, 1974.

Canned Squid Strips (Chunks)

Steps A through E as described above.

f. Cut squid into desired shape.

g. Fill cans 2/3 full and add brine.

Composition of brine:

1 liter water
20 grams salt
20 grams sucrose
1 gram citric acid
2 grams monosodium glutamate

h. Exhaust cans in a water bath at 95-97°C for 8 minutes. This is the length of time required to bring the temperature at the center of the can to 75°C.

i. Seal cans.

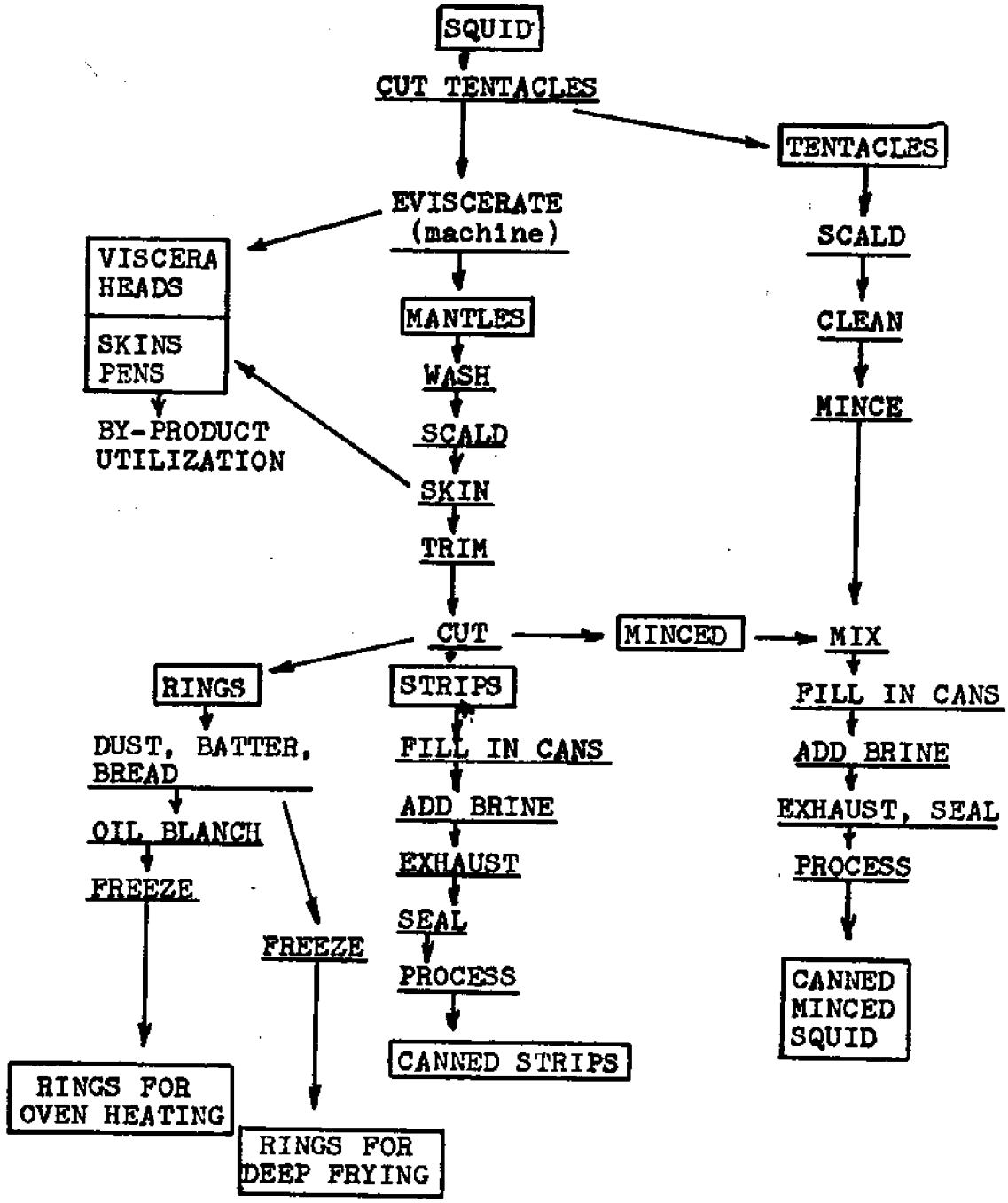
j. Process cans in a retort at 115°C for 40 minutes.

Minced Squid

Preparation of this product is basically the same as that of squid strips. Only the cutting phase is different.

Figure A-1 gives a graphical flow chart of the preparation procedures.

Exhibit A-1


SQUID
CUT TENTACLES
TENTACLES
EVISCERATE (machine)
SCALD
VISCERA
HEADS
SKINS
PENS
MANTLES
CLEAN
WASH
MINCE
BY-PRODUCT UTILIZATION
SCALD
SKIN
TRIM
CUT
MINCED
MIX
RINGS
STRIPS
FILL IN CANS
DUST, BATTER, BREAD
FILL IN CANS
ADD BRINE
ADD BRINE
EXHAUST, SEAL
OIL BLANCH
EXHAUST
PROCESS
FREEZE
SEAL
FREEZE
PROCESS
CANNED MINCED SQUID
CANNED STRIPS
RINGS FOR OVEN HEATING
RINGS FOR DEEP FRYING

Squid Chowder (12 Servings)

Ingredients:
6 tablespoons butter
1/2 cup chopped onion
2 cups boiling water
4 cups potato cubes
2 teaspoons salt
1/4 teaspoon pepper
4 cans minced squid
5 cups scalded milk and cream
(3 cups milk and 2 cups cream)

Preparation:

a. Saute onion in butter.

b. Add water, potato cubes, salt and pepper.

c. Boil until potatos are soft.

d. Add squid and heat.

e. Add milk and cream and serve.

Appendix B

Production Costs for the Berk Mechanized Squid Cleaner[1]

Fixed Investment Costs

Assumption: squid lines are added to existing fish processing plant. No additional space, other than freezer space required.

A) Fried squid rings line — in 000$

	1 ton/hr*	5 tons/hr	10 tons/hr
Raw material handling	30	125	250
Eviscerating, cleaning & blanching	6	20	40
Cutting	6	10	15
Battering & breading	12	40	80
Freeze tunnel	12	40	80
Manual packaging tables	2	6	10
Product storage (frozen 0°F) for 1 month production	50	200	400

B) Canned goods line — in 000$

	1 ton/hr	5 tons/hr	10 tons/hr
Raw material handling	30	125	250
Eviscerating, cleaning & blanching	6	20	40

* Raw squid input rate

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1 All cost estimates were supplied by Professor Zeki Berk.

Cutting	6	20	40
Filler	8	12	20
Brine preparation line	2	5	8
Exhaustion (bath to heat cans)	2	5	8
Sealer	8	20	40
Retorts & controls	3	9	18
Casing & labelling	4	4	8
Product storage (1 month)	15	60	120

Direct Production Costs

A) Frozen squid rings

Per 1000 10 ounce packages, assuming 60% squid, 40% coating.

Squid	1000 lbs.
Batter (dry)	100 lbs.
Breading	250 lbs.
Boxes & wrapping	1030
Cases	80
Steam	negligable
Power	5 kwh
Labor - unskilled	8 man-hrs

B) Minced canned squid

Per 1000 No. 1 cans (300 grams)

Squid	800 lbs.	Cans	1030

Salt	5 lbs.	Cases	24
Sugar	5 lbs.	Steam	300 lbs.
Cirtic Acid	0.25 lb.	Power	3 kwh
MSG	0.50 lb.	Labor - unskilled	10 man-hr

C) Canned strips

Per 1000 No. 1 cans (300 grams)

Squid	1000 lbs.
Salt	5 lbs.
Cans	1030
Cases	24
Steam	300 lbs.
Power	3 kwh.
Labor - unskilled	13 man-hrs.

Appendix C

Mail Questionnaire Interview Form

and

Statistical Analysis

Telephone Area Code 617
233-5100

Cable FOODSCI

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge, Massachusetts 02139
U. S. A.

Department of Nutrition and Food Science

Dear consumer,

Hello. I am a graduate student at M.I.T. As part of my program of studies I am doing research on the shopping habits of Boston area consumers. In an attempt to further my knowledge in this area I have constructed a questionnaire which I ask you to fill out. The questionnaire is not long and should take less than 15 minutes to fill out. In fact, you may find that you will have fun in doing it.

You have been randomly selected from the telephone directory to participate in this survey. Let me assure you that your responses will be kept confidential. In fact, your name need not appear on the completed questionnaire at all.

In order to facilitate mailing a self-addressed stamped envelope has been enclosed.

Your answers are quite important and I do hope you can find the time to complete the questionnaire. Thank you very much for your time and help.

Sincerely,
Paul Kalikstein
Paul Kalikstein

In the first part of the questionnaire I will ask you to put yourself in the following situation:

You are in a supermarket doing your food grocery shopping. You are contemplating three meals to make at home; all of which will start with a bowl of soup. The supermarket has a selection of eight varieties. How many cans of each will you buy?

Remember, you may buy more than one can of a particular variety. However, you must buy a total of three cans of soup.

All soups are condensed and require the addition of an equal portion of milk. All cans are 11 ounces.

A list of ingredients may be found on the last page of this questionnaire.

	Number cans purchased
1) CREAM OF CHICKEN - 19¢	_____
2) CLAM CHOWDER - 35¢	_____
3) OYSTER STEW - 47¢	_____
4) TOMATO - 14¢	_____
5) SQUID CHOWDER - 35¢	_____
6) CREAM OF SHRIMP - 51¢	_____
7) CREAM OF MUSHROOM - 18¢	_____
8) MINESTRONE - 22¢	_____

The next part of the questionnaire is similar to the first part. The difference now is that I will ask you to choose among eight different lunchtime main dishes. Again you are to choose three items, and may again choose more than one of each.

1) BEEF STEW - 15 ounce can - 63¢	_____
2) FRIED CLAMS - net weight 5 ounces - 67¢	_____
3) CHEESE RAVIOLI - 12 ounces - frozen - 61¢	_____
4) SEA SCALLOPS - 7 ounces - frozen - $1.15	_____
5) SQUID RINGS - 7 ounces -frozen - 53¢	_____
6) MACARONI & CHEESE - 12 ounces-frozen-61¢	_____
7) SPAGHETTI & MEATBALLS - 15 ounce can- 49¢	_____
8) CHICKEN TV DINNER - 79¢	_____

In fact, we at M.I.T. are experimenting with the use of squid in a variety of supermarket type food products. We are aware that most people do not even know what squid is. However, if you do know what squid is please complete the rest of the questionnaire. If you do not know what squid is, please return the questionnaire without filling out the remaining sections.

Briefly describe what squid means to you. _____

_____

_____

Have you ever eaten squid? Yes ☐ No ☐

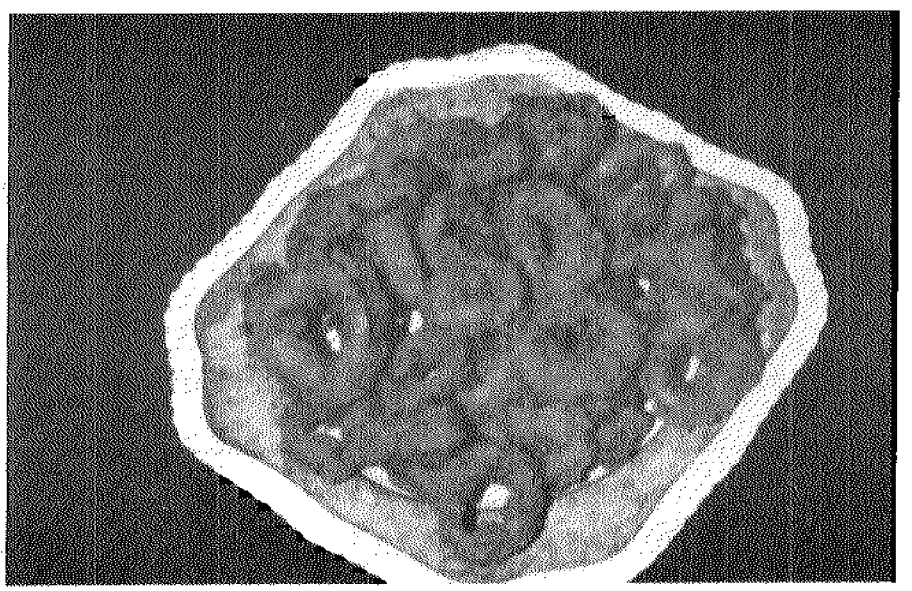
Are you the major food shopper in your household? Yes ☐ No ☐

How many times a week do you eat fish? _____

Male ☐ Female ☐

Family Income - Below $5,000 ☐
$5,000 - $12,000 ☐
$12,000 - $20,000 ☐
Above $20,000 ☐

Here is a picture of one of the products which we at M.I.T. are testing. We call it SQUID RINGS. It is a frozen food form made up of squid and a crisp breaded coating. It can be frozen for an indefinite period and then simply dropped into an oven for 15 minutes to prepare.



Finally, please mark down (circle the appropriate spot) whether you AGREE STRONGLY, AGREE, ARE NEUTRAL, DISAGREE or DISAGREE STRONGLY with the following statements.

	AGREE STRONGLY	AGREE	NEUTRAL	DISAGREE	DISAGREE STRONGLY
Eat squid, you've got to be kidding.	X	X	X	X	X
I'd probably feel sick if I ate squid.	X	X	X	X	X
Lots of people like squid.	X	X	X	X	X
Squid is a low calorie food, therefore is good for diets.	X	X	X	X	X
Squid is very hard to find.	X	X	X	X	X
I wouldn't eat squid if you gave me 5 dollars.	X	X	X	X	X
I wouldn't eat squid if you gave me 100 dollars.	X	X	X	X	X
Squid stays fresh for a long time.	X	X	X	X	X
Squid is healthy to eat.	X	X	X	X	X

Please place the questionnaire in the self-addressed stamped envelope and mail it as soon as possible. Let me again thank you for taking the time to complete this questionnaire and in helping further our research.

Ingredients List

Soups

CREAM OF CHICKEN - Chicken Broth, Chicken, Wheat Flour, Cream, Carrots, Salt, Vegetable Oil, Food Starch, Celery, Sugar, Nonfat Dry Milk, Chicken Fat, Flavoring including Onion, Monosodium Glutamate, Paprika

CLAM CHOWDER - Water, Clams, Potatos, Flour, Butter, Fresh Onions, Shortening, Salt, Sugar and Flavorings

OYSTER STEW - Milk, Oysters, Water, Butter, Salt, Monosodium Glutamate, Disodium Phosphate, Sodium Bicarbonate, Spices

TOMATO - Tomatoes, Sugar, Food Starch-Modified, Wheat Flour, Salts, Onions, Cream, Soy Oil, Spice, Flavoring

SEA FOOD - Water, Potatos, Squid, Red Peppers, Wheat Flour, Vegetable Oil, Monosodium Glutamate, Onions, Flavoring

CREAM OF SHRIMP - Water, Shrimp, Cream, Sauterne Wine, Tomatos, Margarine, Wheat Flour, Food Starch, Monosodium Glutamate, Salt, Sugar, Onions, Flavoring

CREAM OF MUSHROOM- Water, Mushrooms, Vegetable Oil, Whaet Flour, Cream, Margarine, Salt, Sugar, Tomatos, Dry Milk, Monosodium Glutamate, Flavoring

MINESTRONE - Beef Stock, Carrots, Potatos, Tomatos, Water, Celery, Peas, Green Beans, Zucchini, Salt, Sugar, Vegetable Oil, Cheddar Cheese, Spinach, Monosodoium Glutamate, Onions, Flavoring

Lunch Main Dishes

BEEF STEW - Beef Stock, Potatos, Cooked Beef, Carrots, Peas, Tomatos, Water, Potato Starch, Vegetable Oil, Wheat Flour, Salt, Corn Starch, Sugar, Onions

FRIED CLAMS - Clams, Flour, Corn Meal, Dry Milk, Pickle Relish, Vegetable Shortening, Onions, Sugar, Salt, Monosodium Glutamate, Spices

CHEESE RAVIOLI - Water, Semolina Flour, Ricotta Cheese, Eggs, Parmesan Cheese, Vegetable Oil, Food Starch, Salt, Spices, Tomato Puree, Corn syrup, Olive Oil

SEA SCALLOPS - Sea Scallops, Toasted Wheat, Water, Corn Flour, Dry Milk Solids, Dried Whey, Salt, Dried Eggs, Dextrose, Sucrose, Vegetable Oil, Spices

SEAFOOD - Squid, Flour, Corn Meal, Vegetable Shortening, Dry Milk, Onions, Salt, Sugar, Monosodium Glutamate, Spices

MACARONI & CHEESE- Skim Milk, Macaroni, Cheese, Flour, Margarine, Vegetable Oil, Salt, Monosodium Glutamate

SPAGHETTI & MEATBALLS - Beef, Spaghetti, Water, Sugar, Cheddar Cheese, Salt, Carrots, Onions, Citric Acid, Flavoring

CHICKEN TV DINNER - Chicken, Potatos, Sugar, Salt, Vegetable Oil, Corn Syrup, Wheat Flour, Spices, Dry Milk, Monosodium Glutamate, Flavoring

Appendix C - Section 2

Calculations to Determine the Effect of Picture Insertion on Respondents' Attitude Score

Chi-Square Analysis

$$\chi^2 = \Sigma \frac{(e-o)^2}{e}$$

by groupings from Exhibit 6-5, assuming WITHOUT PICTURE to be EXPECTED case, and WITH PICTURE to be OBSERVED case

$$\chi^2 = \frac{(4-0)^2}{4} + \frac{(2-2)^2}{2} + \frac{(4-2)^2}{4} + \frac{(5-4)^2}{5} + \frac{(5-7)^2}{5}$$
$$+ \frac{(13-14)^2}{13} + \frac{(17-10)^2}{17} + \frac{(4-7)^2}{4} + \frac{(3-3)^2}{3} = 11.207$$

χ^2 with 8 degrees of freedom.

Distributions are significantly different at .15 level.

Difference in Means Analysis

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

Let: WITH PICTURE = 1
WITHOUT PICTURE = 2

$$Z = \frac{20.1 - 15.8}{\sqrt{\frac{16}{49} + \frac{21.9}{57}}} = 5.1$$

If normality is assumed, means are significantly different at .005 level of significance.

BMD07M - STEPWISE DISCRIMINANT ANALYSIS - REVISED FEBRUARY 2, 1973
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PROBLEM CODE DISANL

NUMBER OF VARIABLES 5

NUMBER OF GROUPS 2

NUMBER OF CASES IN EACH GROUP 7 46

PRIOR PROBABILITIES 0.5000 0.5000

VARIABLE FORMAT (6X,F1.0,1X,F1.0,5X,F1.0,3X,F3.1,5X,F5.1)

DATA INPUT FROM CARDS

MEANS (THE LAST COLUMN CONTAINS THE GRAND MEANS OVER THE GROUPS USED IN THE

VARIABLE	GROUP PURCHS	NOPURC	
1	0.0	0.32609	0.28302
2	0.71429	0.41304	0.45283
3	0.57143	0.34783	0.37736
4	2.14286	1.60870	1.67924
5	8.14286	-5.43478	-3.64151

STANDARD DEVIATIONS

VARIABLE	GROUP PURCHS	NOPURC
1	0.0	0.47396
2	0.48795	0.49782
3	0.53452	0.48154
4	0.85217	1.24237
5	16.93298	24.66385

WITHIN GROUPS COVARIANCE MATRIX

	VARIABLES 1	2	3	4	5
VARIABLE					
1	0.19821				
2	-0.12148	0.24668			
3	0.03495	-0.06796	0.23822		
4	0.08568	0.01413	0.03313	1.44732	
5	1.11807	-2.16575	2.24284	7.96136	570.47217

WITHIN GROUPS CORRELATION MATRIX

	VARIABLES 1	2	3	4	5
VARIABLE					
1	1.00000				
2	-0.54940	1.00000			
3	0.16086	-0.28034	1.00000		
4	0.15996	0.02364	0.05642	1.00000	
5	0.10515	-0.18257	0.19240	0.27707	1.00000

```
SUBPROBLEM                    1
F-LEVEL FOR INCLUSION   0.0
F-LEVEL FOR DELETION    0.0
TOLERANCE LEVEL         0.0
CONTROL VALUES        11111

*****************************************************************************

STEP NUMBER         0
VARIABLE ENTERED

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM     1   51

  1   3.2593          2   2.2350          3   1.2751          4   1.1977          5   1.

*****************************************************************************

STEP NUMBER         1
VARIABLE ENTERED    1

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM     1   51

  1   3.2593

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM     1   50

  2   0.3341          3   1.9065          4   1.8093          5   2.3587

U-STATISTIC           0.93993      DEGREES OF FREEDOM     1     1   51
APPROXIMATE F         3.25928      DEGREES OF FREEDOM     1    51.00
```

F MATRIX - DEGREES OF FREEDOM 1 51

GROUP	PURCHS
NOPURC	3.25929

FUNCTION	PURCHS	NOPURC
VARIABLE		
1	0.0	1.64516
CONSTANT	-0.69315	-0.96138

NUMBER OF CASES CLASSIFIED INTO GROUP -

GROUP.	PURCHS	NOPURC
PURCHS	7	0
NOPURC	31	15

****

STEP NUMBER 2
VARIABLE ENTERED 5

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM 1 50

1	3.6399	5	2.3587

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM 1 49

```
  2    0.6262          3    1.1829          4    0.9856

U-STATISTIC           0.89759      DEGREES OF FREEDOM    2     1    51
APPROXIMATE F         2.85240      DEGREES OF FREEDOM    2    50.00

F MATRIX - DEGREES OF FREEDOM     2    50

             GROUP
            PURCHS
GROUP
NOPURC       2.85240

            FUNCTION
             PURCHS          NOPURC
VARIABLE
  1        -0.08142         1.71790
  5         0.01443        -0.01289

CONSTANT
           -0.75191        -1.00828

             NUMBER OF CASES CLASSIFIED INTO GROUP -
            PURCHS NOPURC
GROUP
 PURCHS       6       1
 NOPURC      19      27

*************************************************************************************

STEP NUMBER          3
VARIABLE ENTERED     3

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM     1    49
```

```
  1    4.0672          3    1.1829          5    1.6201

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM    1    48

  2    1.0450          4    0.8805

U-STATISTIC           0.87643     DEGREES OF FREEDOM    3     1    51
APPROXIMATE F         2.30287     DEGREES OF FREEDOM    3    49.00

F MATRIX - DEGREES OF FREEDOM    3    49

             GROUP
            PURCHS
GROUP
NOPURC       2.30286

            FUNCTION
             PURCHS          NOPURC
VARIABLE
  1        -0.45748         1.49812
  3         2.41237         1.40984
  5         0.00569        -0.01801

CONSTANT
           -1.40554        -1.23152

             NUMBER OF CASES CLASSIFIED INTO GROUP -
            PURCHS NOPURC
GROUP
 PURCHS        5       2
 NOPURC       13      33
```

****

STEP NUMBER 4
VARIABLE ENTERED 2

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM 1 48

1 1.1881 2 1.0450 3 1.5952 5 1.8453

VARIABLES NOT INCLUDED AND F TO ENTER - DEGREES OF FREEDOM 1 47

4 0.5579

U-STATISTIC 0.85776 DEGREES OF FREEDOM 4 1 51
APPROXIMATE F 1.99000 DEGREES OF FREEDOM 4 48.00

F MATRIX - DEGREES OF FREEDOM 4 48

	GROUP PURCHS
GROUP NOPURC	1.98999

	FUNCTION PURCHS	NOPURC
VARIABLE		
1	2.49994	3.80696
2	5.19273	4.05394
3	3.36398	2.15275
5	0.01586	-0.01006
CONSTANT	-3.57341	-2.55281

```
                NUMBER OF CASES CLASSIFIED INTO GROUP -
               PURCHS NOPURC
GROUP
 PURCHS          5       2
 NOPURC         14      32

*************************************************************************************

STEP NUMBER          5
VARIABLE ENTERED     4

VARIABLES INCLUDED AND F TO REMOVE - DEGREES OF FREEDOM     1    47

  1    1.4694          2    0.7180          3    1.4980          4    0.5579          5    1.1

U-STATISTIC            0.84769      DEGREES OF FREEDOM     5     1    51
APPROXIMATE F          1.68892      DEGREES OF FREEDOM     5    47.00

F MATRIX - DEGREES OF FREEDOM     5    47

               GROUP
              PURCHS
GROUP
NOPURC       1.68891

F LEVEL INSUFFICIENT FOR FURTHER COMPUTATION

              FUNCTION
               PURCHS          NOPURC
VARIABLE
  1          1.65245         3.16042
  2          4.52066         3.54123
```

3	3.29255	2.09826
4	1.27742	0.97453
5	-0.00257	-0.02413

CONSTANT

-4.60658 -3.15411

GROUP WITH LARGEST PROB.		SQUARE OF DISTANCE FROM AND POSTERIOR PROBABILITY FOR GROUP -	
GROUP PURCHS		PURCHS	NOPURC
CASE			
1	PURCHS	3.983 0.755,	6.230 0.245,
2	PURCHS	3.222 0.669,	4.628 0.331,
3	PURCHS	2.148 0.779,	4.672 0.221,
4	PURCHS	1.733 0.824,	4.819 0.176,
5	NOPURC	2.584 0.431,	2.028 0.569,
6	PURCHS	2.891 0.704,	4.625 0.296,
7	PURCHS	3.262 0.515,	3.379 0.485,

GROUP NOPURC		PURCHS	NOPURC
CASE			
1	NOPURC	7.081 0.271,	5.104 0.729,
2	NOPURC	8.451 0.073,	3.354 0.927,
3	PURCHS	5.194 0.530,	5.434 0.470,
4	NOPURC	6.220 0.220,	3.684 0.780,
5	NOPURC	2.005 0.450,	1.601 0.550,
6	NOPURC	6.750 0.212,	4.127 0.788,
7	NOPURC	9.341 0.060,	3.832 0.940,
8	NOPURC	8.256 0.078,	3.310 0.922,
9	NOPURC	3.713 0.418,	3.048 0.582,
10	NOPURC	5.393 0.402,	4.598 0.598,

11	NOPURC	8.499	0.196,	5.679	0.804,
12	PURCHS	1.666	0.594,	2.428	0.406,
13	NOPURC	2.717	0.476,	2.528	0.524,
14	PURCHS	3.814	0.562,	4.313	0.438,
15	PURCHS	1.609	0.541,	1.939	0.459,
16	PURCHS	3.681	0.594,	4.441	0.406,
17	NOPURC	10.912	0.386,	9.984	0.614,
18	NOPURC	8.227	0.196,	5.409	0.804,
19	NOPURC	8.227	0.196,	5.409	0.804,
20	NOPURC	9.727	0.327,	8.287	0.673,
21	NOPURC	4.266	0.291,	2.482	0.709,
22	NOPURC	8.824	0.127,	4.970	0.873,
23	PURCHS	3.876	0.656,	5.171	0.344,
24	NOPURC	10.443	0.049,	4.505	0.951,
25	NOPURC	12.826	0.250,	10.624	0.750,
26	PURCHS	9.359	0.569,	9.911	0.431,
27	PURCHS	1.831	0.594,	2.592	0.406,
28	NOPURC	7.350	0.377,	6.344	0.623,
29	NOPURC	10.360	0.105,	6.080	0.895,
30	NOPURC	5.683	0.328,	4.246	0.672,
31	PURCHS	2.916	0.916,	7.685	0.084,
32	NOPURC	11.027	0.037,	4.483	0.963,
33	NOPURC	5.963	0.359,	4.806	0.641,
34	PURCHS	7.518	0.832,	10.722	0.168,
35	PURCHS	4.088	0.751,	6.294	0.249,
36	NOPURC	6.742	0.188,	3.818	0.812,
37	NOPURC	2.801	0.379,	1.814	0.621,
38	NOPURC	7.677	0.160,	4.362	0.840,
39	NOPURC	10.590	0.480,	10.431	0.520,
40	NOPURC	6.066	0.278,	4.155	0.722,
41	NOPURC	7.130	0.212,	4.505	0.788,
42	NOPURC	12.618	0.074.	7.558	0.926.

43	NOPURC	3.935 0.304,	2.280 0.696,
44	NOPURC	10.660 0.047,	4.657 0.953,
45	NOPURC	5.999 0.476,	5.811 0.524,
46	PURCHS	2.523 0.872,	6.362 0.128,

NUMBER OF CASES CLASSIFIED INTO GROUP -

GROUP	PURCHS	NOPURC
PURCHS	6	1
NOPURC	12	34

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC
1	1		3.2593	1	0.9399
2	5		2.3587	2	0.8976
3	3		1.1829	3	0.8764
4	2		1.0450	4	0.8578
5	4		0.5579	5	0.8477